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The following rules will govern this competition:

1. The award of the prize to be made by the Board of Control, voting by ballot and without knowledge of the names of the competitors.

2. Each competitor to send his essay to the Secretary-Treasurer in a sealed envelope marked "Prize Essay Contest." The name of the writer shall not appear on the essay, but instead thereof a motto. Accompanying the essay a separate sealed envelope will be sent to the Secretary-Treasurer, with the motto on the outside and the writer's name and motto inside. This envelope will not be opened until after the decision of the board. Essays must be received on or before January 1, 1929.

3. In addition to the "Naval Institute Prize," one or more essays may receive "Honorable Mention," if of sufficient merit to justify that award; or, in the event that no essay is adjudged of sufficient merit to receive the "Prize," the best essay submitted may receive "Honorable Mention" in lieu thereof.

4. In case one or more essays receive "Honorable Mention" the writers thereof will each receive a prize, the amount of such awards to be decided by the Board of Control in each case.

5. Announcement of awards will be made as soon as practicable after January 1, 1929.

6. Essays awarded the "Naval Institute Prize" or "Honorable Mention" will be published in the NAVAL INSTITUTE PROCEEDINGS as soon as practicable. Essays not awarded a prize may be published at the discretion of the Board of Control, and the writers of such articles shall be compensated at the established rate for articles not submitted in competition.

7. Articles shall be limited to eleven (11) printed pages in the PROCEEDINGS (approximately 8,000 words), but shorter articles will receive equal consideration.

8. In the event of the prize being awarded to the winner of a previous year, a gold clasp suitably engraved will be given in lieu of the medal.

9. All essays must be typewritten, double spaced, and submitted in duplicate.

R. C. MACFALL
Captain, U.S.N., Secretary-Treasurer

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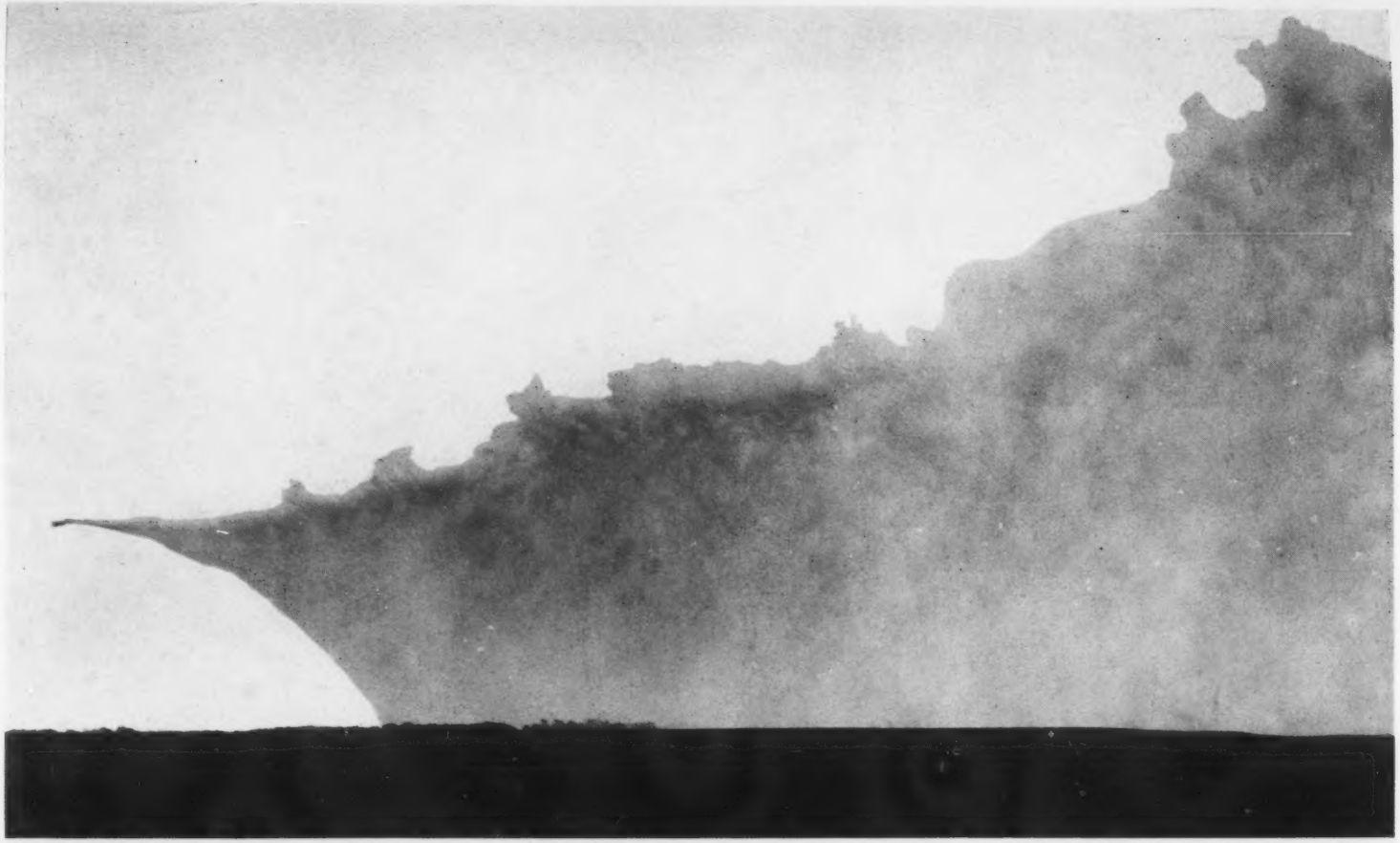
LIGHT TANK LAYING SMOKE SCREEN

Official Photograph, U.S. Army Air Corps.

LIGHT TANK LAYING SMOKE SCREEN



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MARTIN BOMBER LAYING A SMOKE CURTAIN

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FLOATING SMOKE BOMBS

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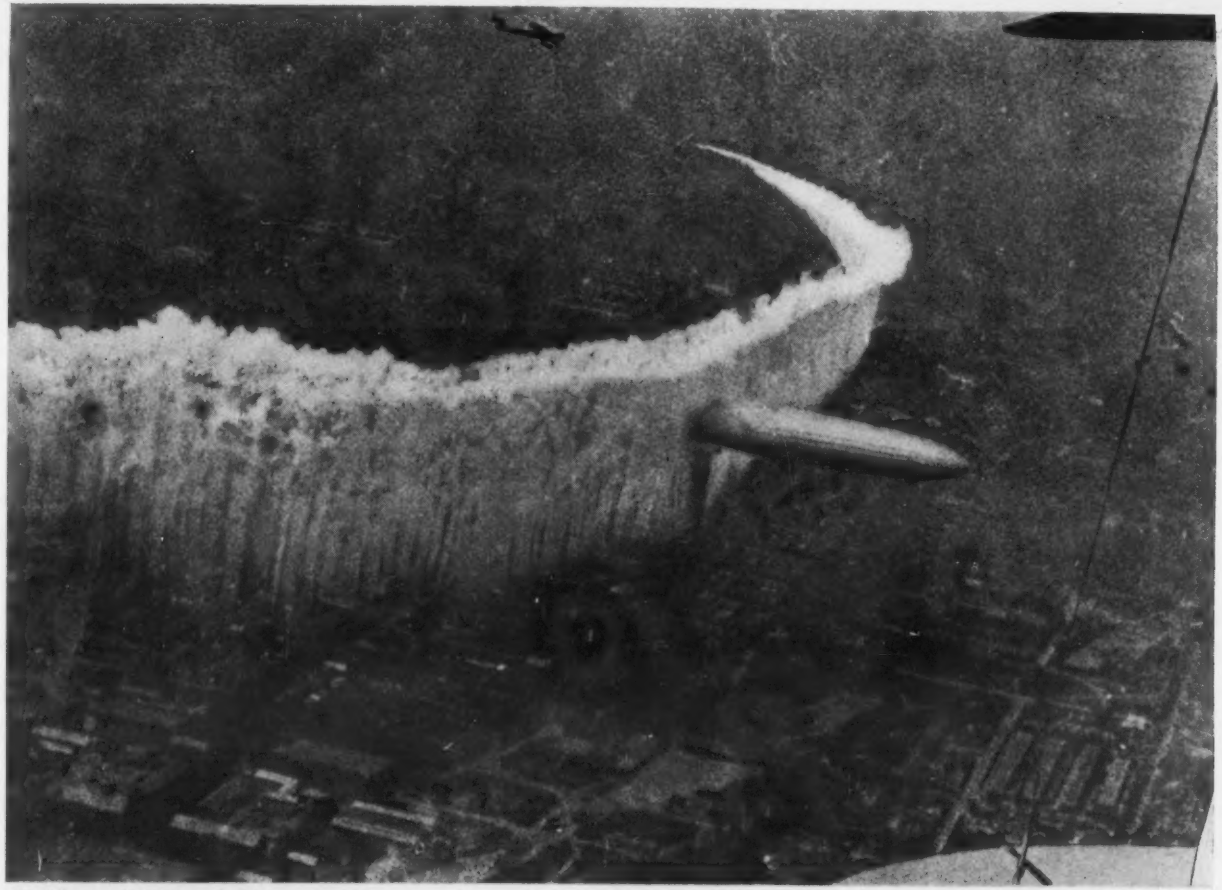
FLOATING SMOKE BOMBS



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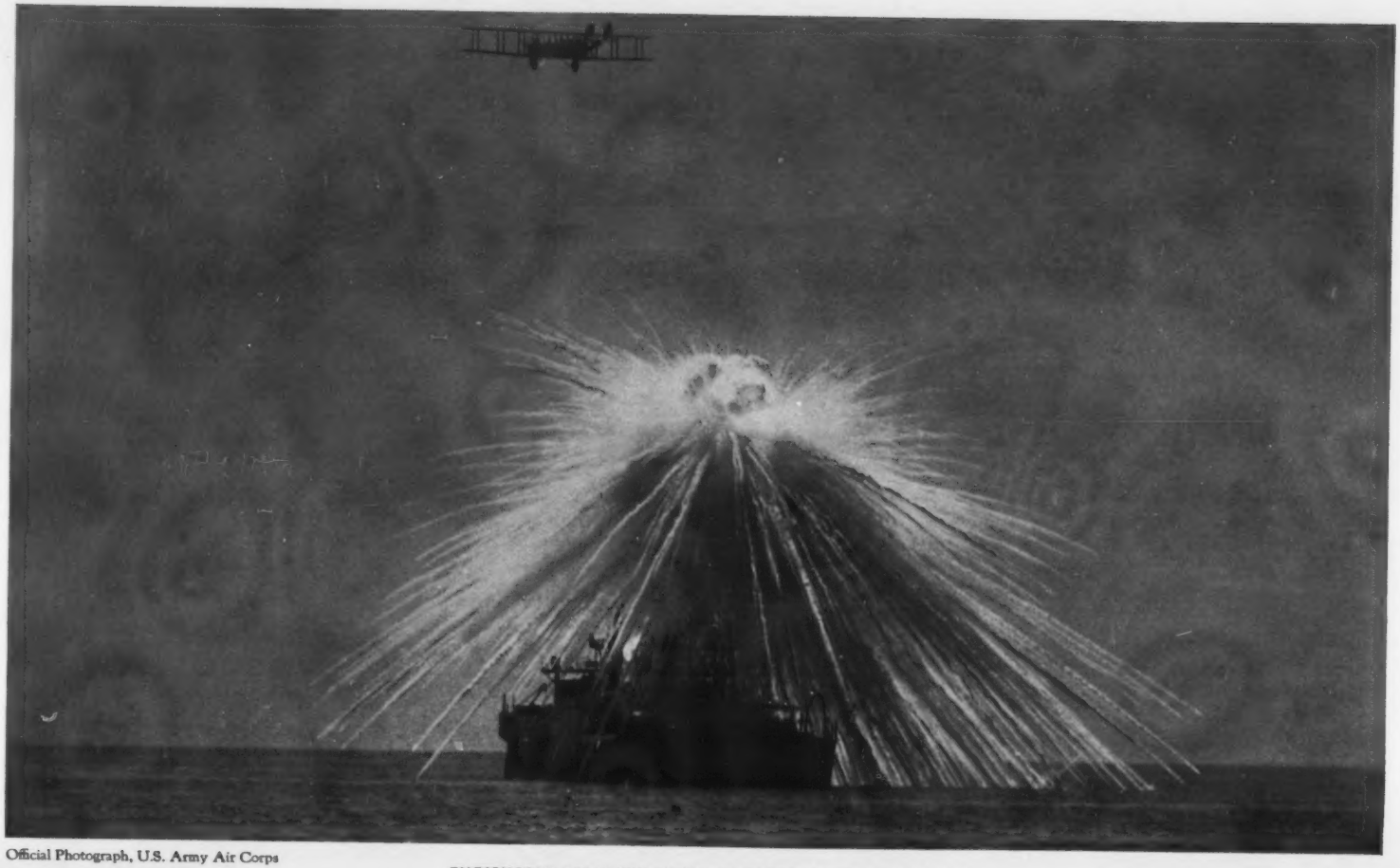
DIRIGIBLE PASSING THROUGH SMOKE CURTAIN



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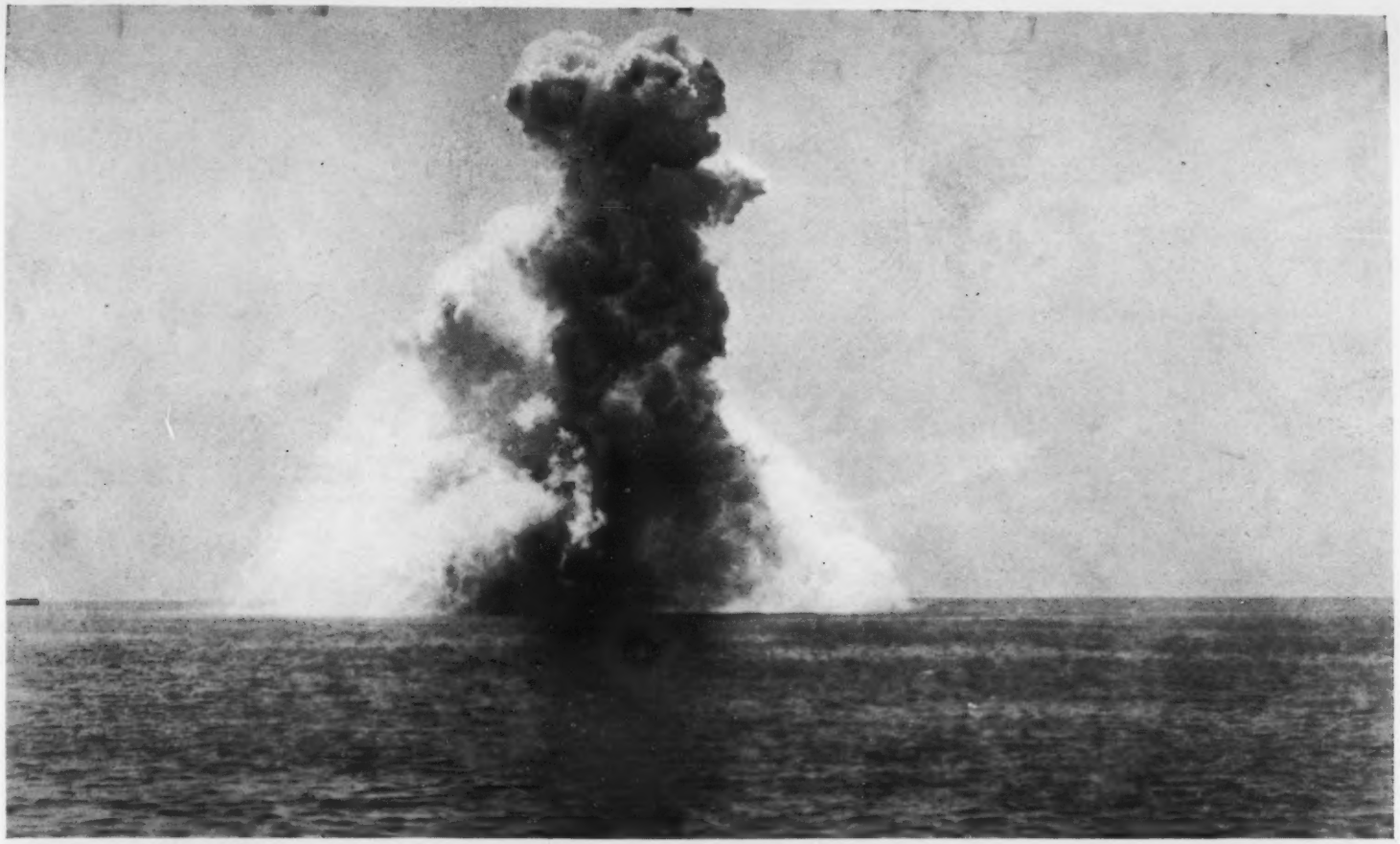
PHOSPHORUS BOMB EXPLODING IN CROW'S NEST OF *ALABAMA*

Official Photograph, U.S. Army Air Corps

PHOSPHORUS BOMB EXPLODING IN CROW'S NEST OF *ALABAMA*



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THE *ALABAMA* SHROUDED IN SMOKE

Thirty minutes after the explosion of the phosphorus bomb in her top.

Official Photograph, U.S. Army Air Corps

STANDING SMOKE CURTAIN

Official Photograph, U.S. Army Air Corps

BLINDING THE ENEMY

Planes laying smoke screens around the target.

Navy Recruiting Bureau, New York

SMOKE SCREEN USED IN CONNECTION WITH FLEET MANEUVERS

Navy Recruiting Bureau, New York

SMOKE SCREEN USED IN CONNECTION WITH FLEET MANEUVERS

UNIV. OF MICH.

The Age of Sail and Steam

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PROCEEDINGS

Vol. No. 54, No. 8 AUGUST, 1928 *Whole No. 306*

Some Naval Aspects *of* Chemical Warfare

By MAJOR GENERAL AMOS A. FRIES, *U. S. Army*
Chief of Chemical Warfare

SOMEONE has said that novelty is a mental stimulant not tolerated by single cylinder minds; all exponents of new ideas in warfare can testify to the truth of this statement. Although twelve years have passed since the first German gas attack at Ypres, such war measures have not ceased to be thought novel. Any consideration of naval aspects of the use of chemical agents in battle, however, finds sound basis in the statement of our own high priest of naval warfare, Admiral Mahan; for it was this great sea tactician and strategist who, at the Hague Convention of 1899, refused for the American government to be a party to a declaration which provided that no signatory power should employ poisonous, asphyxiating, or similar materials in shells. He stated his views as follows:

> The objection that a machine of war is barbarous has always been raised against new weapons, which were nevertheless finally adopted. In the Middle Ages it was firearms which were denounced as cruel. Later, shells, and more recently, torpedoes have been denounced. It seems to me that it cannot be proved that shells with asphyxiating gases are inhumane or unnecessarily cruel machines of war, and that they cannot produce decisive results. I represent a people that is animated by a lively desire to make warfare more humane, but which may nevertheless find itself forced to wage war; therefore it is a question of not depriving itself through hastily adopted resolutions of means of which it could later avail itself with good results.

Sound uses of chemistry in war, however, are a matter of history as far back as the eighth century.

Callinicus was an architect and not an admiral, but his Greek fire which prolonged the life of the Eastern Roman Empire for some 750 years was shot from naval vessels by a hand pump; and thus 1,200 years ago the Byzantine navy by the employment of chemical agents saved a large part of Christendom from Mohammedan rule. Liquid fire has gone into the limbo with bows and arrows, but its chemical successors, gas and smoke, seem destined to play an important part in both land and naval warfare.

History reveals that the naval successors to the Greek emperors have not failed through the years to devote a considerable amount of thought to the use of chemical implements of war. It is recorded that an English naval commander in the reign of Henry III defeated a French fleet by maneuvering his ships to windward and throwing a large amount of finely powdered quicklime on the French vessels.

Now that purely naval actions may be fought with the opposing fleets hull down to each other, such obvious uses of chemical agents are impracticable; nevertheless, with gas, the "weather gauge" may again be of vital importance. As the element of surprise in warfare is equally important afloat or ashore, an understanding of the powers and limitations of chemical agents appears to be as necessary a part of the education of naval officers as it is of their military brethren.

The Chinese "stink pots," and Admiral Dundonald's "Secret," which had to do with

the subjugation of the defenses of Sebastopol in the Crimean War, and Mr. Winston Churchill's earnest advocacy of smoke for use in sea operations during the World War, are indicative of the amount of naval study which has been devoted to these subjects since the days of Greek fire.

It is very doubtful if the blocking operations of Zeebrugge and Ostend could have been successful without the powerful assistance lent by smoke. Why its obvious use was neglected at the Dardanelles and by ourselves for the assistance of Hobson's blockading expedition in the Spanish-American War is hard to understand.

Smoke on a large scale offers a great variety of naval uses and can be projected or dropped in so many ways that naval campaigns of the future may possibly be determined by it. Since ships nowadays are so constructed that breathing in of the surrounding atmosphere is essential to life on board them, it is idle to contend that because high explosives are in general more damaging to ships than are noxious gases, the use of the latter need not be expected.

It is reasonable to suppose that naval constructors will so improve ship design that the sudden sinkings of first line vessels as happened at Jutland will be far less probable in the future; but since the modern battleship contains about a million cubic feet of air space and since only sixty to eighty pounds of mustard gas would be needed to create a casualty producing atmosphere, or six pounds of tear gas for an intolerable concentration in a space of this size, it is certain that some nation will eventually devise a means for placing this small amount of chemical agent aboard naval vessels. Wars, large and small, engaged in by naval powers usually embrace landing operations, where the tremendous possibilities for wide use of both smoke and gas, including harmless tear gas, must be seriously considered.

Armies in many cases can evacuate gas contaminated ground; but naval actions are decided on the decks of the ships on which they are begun. While the abandonment of known and tried weapons in favor of chemical agents, the naval uses of which are still problematical, is not advocated, a surprise attack with chemical agents skillfully delivered and followed up with determination might well in a single day wrench the control of the seas from a more powerful naval adversary.

No branch of the Army is so close to the Navy as is the Chemical Warfare Service. With naval funds allotted for that purpose, we have carried on at Edgewood Arsenal, Maryland, such research and development work, and such training in the use of and protection against chemical agents as the Navy has desired. There is maintained at Edgewood a naval unit, and some three hundred officers and almost that many petty officers of the Navy have been instructed in chemical fundamentals at the chemical warfare school. This close association has given us very concrete ideas as to the naval needs along the lines of protection and the advantage of naval opinion as to the uses afloat of gas and smoke. Since chemical agents offer many advantages for Marine Corps operations, training of that important branch of the national defense in the use of chemical weapons has also had its inception at Edgewood.

There has been a very general misconception even in the military services as to the international status of chemical warfare, and this may be briefly summed up in one sentence so far as the United States is concerned: the United States is bound by no treaty whatsoever which prohibits the use of either gas or smoke in peace or war, though several such have been proposed. Nor does any treaty which has been contemplated prohibit the use of smokes or non-toxic gases such as the tear gas now used by the police in all large cities (as per ruling from the Judge Advocate General). According to a letter from the State Department, published in the *Congressional Record* of December 13, 1926, we would not be prohibited from full peace time preparation to combat effectively any enemy employing gas were treaties now proposed, finally adopted.

As military servants in the national defense, it is clearly our duty to prepare in every proper way to utilize all effective weapons of war. We of the military profession must determine this effectiveness and present clearly to our civil superiors the dangers and benefits which we may expect from the use of any particular weapon. The responsibility for policies and for funds to carry on such work then rests with the representatives of the people.

Mr. John Hay, Secretary of State, in his instructions to the American delegates at the first peace conference at The Hague in 1899 on the proposal to outlaw the use of gas shells, said:

> The expediency of restraining the inventive genius of our people in the direction of devising means of defense is by no means clear; and considering the temptations to which men and nations may be exposed in a time of conflict, it is doubtful if an international agreement to this end would be effective. The dissent of a single powerful nation might render it altogether nugatory. The delegates are, therefore, enjoined not to give the weight of their influence to the promotion of projects the realization of which is so uncertain.

It is an unquestioned fact that the more scientific a people and the more developed its industries and resources, the more easily can this modern weapon be utilized. Today that nation is most powerfully defended whose peace time industries can most quickly and easily be diverted to war uses; and nations will use for fighting, when they can, those things which are most readily available. It is a fair assumption that in the future weapons will tend more and more to be produced by the transformation of peace time implements. At the beginning of the World War, Germany was the greatest chemical nation on earth, and produced in her factories yearly many hundreds of tons of chlorine and phosgene for use in her enormous dye and other chemical industries. Research for this dye industry had forced a study of a particular kind of chemistry, and in that range, among other gases later used for war, mustard gas had been discovered and its toxic qualities recorded thirty years before it was used in battle.

Those who have advocated the abolition of the use of chemicals in war on the grounds of cruelty of such agents have long since been driven from their position; and no thinking man today can go over the mass of evidence which has accumulated since 1918 without being forced to disregard the horrible ideas concerning gas which were a necessary part of the Allied propaganda.

Gas was proved to be ten to twelve times as humane as any other method of fighting in the World War. Deaths from gas per hundred of those so wounded among American troops were two; among the Allies about three, because they suffered especially in the early attacks without adequate protection. The deaths from bullets, high explosives, airplane bombs, shell and similar weapons were twenty-five per hundred among Americans; and thirty-six per hundred among the Allies and our enemies; the ratio being twelve to one in every case in favor of gas.

Gas left practically no blind, no maimed, no disfigured and no deformed. Bullets, bayonets, bombs and shells left thousands blind, disfigured, maimed and deformed.

"Poison gas" is a misnomer. There is no essential poison in the great proportion of the so-called warfare gases. They produce their effect by burning, irritation, and corrosion. It is true that some of the toxic smokes, which I will discuss later on, contain arsenic, but the amount which can be absorbed in field concentrations of these substances produces no serious symptoms of arsenic poisoning. Why the chemical weapons should, in the minds of many people, continue to be so dreadfully classed, while high explosives and bayonets are not, can only be a tribute to those who so ably managed war propaganda. That it took from four to eleven months to return each form of German chemical attack, made this propaganda the more bitter.

War chemicals are germ proof; they are so powerful that no germ can live any appreciable time whatever in them. Therefore, the wound caused by the chemical is germ proof, the kind of wound the surgeon always desires to make when he operates. Not only is the chemical, itself, sterile, but its power to destroy bacteria is such that it more or less sterilizes the surface, so that no important after-infection can occur as from bullets and other wounds, except from later outside infection. Accordingly, the chemical having no essential poison, having no germs, cannot produce any lasting after effects with one exception. That exception is where the chemical irritates or burns the lungs or body to such an extent as to seriously impair the general health. All statistics show that such cases are extremely rare. The studies that have been carried on since the war indicate that there are very few, indeed, suffering after effects from gas. This is true notwithstanding all the sob and wild propaganda to the contrary. If these chemicals produced tuberculosis and a host of other diseases frequently attributed to them, then we would all be dead

from chlorine, gasoline, and carbon monoxide in our illuminating gas and a host of other injurious gases which we use and breathe every day of our lives.

For fear I may have given a slightly erroneous idea, I want to say that no one should believe that chemicals are not powerful in war. They are decidedly powerful as shown by the fact that in the American forces over twenty-seven per cent of all casualties, killed and wounded, were gas, although only 1,400 or less died from gas out of the 70,570 wounded, while 50,000 died out of the 188,000 casualties from other weapons.

Without gas masks and clothing to protect against gas, an army cannot live in the presence of gas at all. Like every other evil, including dangerous diseases, a recognition of their power and preparation to meet them is the only guarantee of safety. No "medicine man" or ostrich measures will have any effect.

Humanity in war, is, of course, a very relative term. We are accustomed to consider naval blockade an almost peaceful form of enforcing our will upon an enemy nation, but Colonel J. F. C. Fuller of the British army states in a recent book entitled, *The Foundation of the Science of War*:

> The effectiveness of the navy as an economic weapon is little realized by the general public. The following, told me by a naval friend, quoting the highest authorities, is of interest: "Up till the end of 1918 it is calculated that 763,000 German civilians died as a result of the 'blockade.' The spread of tuberculosis has undone the work of many years before the war, and a large percentage of the children of Germany are more or less affected with rickets. The new generation will be permanently injured, both mentally and physically. The result of the 'blockade' in terms of human misery was unutterably dreadful, but as a measure of war it can only be described as a wonderful success." It appears somewhat cynical that the economic blockade should be the means whereby the League of Nations proposes to enforce its will.

We may not agree with the author, but his viewpoint after much study is worth careful consideration.

The medical research division of the Chemical Warfare Service has spent a great portion of its time since the war in studying, with the assistance of doctors everywhere throughout the United States, the after effects of gas wounds. Their findings agree with those of the medical departments of the armies of other large countries to the effect that, generally speaking, there are no after effects. Talk of insanity and tuberculosis following years after a man has become a casualty from gas is ridiculous. The ease with which injury from gas can be claimed and the difficulty of proving the absence of such injury have led to a tremendous number of pension claims before the United States Veterans' Bureau, a very large portion of which are idle and worthless.

The truth is that chemical science has provided mankind with a weapon which reduces the necessity for killing and brings decisive results with far less permanent injury than in the case of cold steel or explosives.

At the risk of repeating facts now largely known by military men, a brief description of the usual chemical agents seems necessary.

There were used during the War more than twenty-eight different chemical warfare materials. Only three of these are gases at ordinary temperatures and so can be discharged from cylinders under pressure. The others are liquids which gradually evaporate giving off irritating or burning vapors, or they are solids which are irritating when in the form of smoke.

In their effects on human beings these substances are normally divided into four groups.

The first group includes chlorine, and its immediate successor, phosgene. These gases are injurious when breathed, but do not affect the skin or eyes when present in concentrations which are highly irritating to the lungs. This group can be protected against by the use of gas masks, and is of military value largely for local surprise action and against unprotected troops.

The second group, the vesicant or blistering gases, includes mustard gas and the American Lewisite. These so-called gases are really liquids, the vapor from which is casualty producing when breathed, but in addition they cause burns and blisters wherever they touch the skin and on those parts of the body which perspire. A drop of mustard gas on a man's clothing will penetrate through it and cause a burn, the effects of which will last for some six weeks. These gases evaporate so slowly that ground contaminated by them may be dangerous

for two or three weeks. Lewisite was never used in war, but mustard gas caused more casualties than all the other chemical agents combined.

The third group contains substances which are not gases at all, but toxic smokes. While these were comparatively little used during the war, their great importance presents a wide field for research and development. They are usually arsenic compounds, which when burned, give off very fine particles of smoke. Their efficiency lies in the fact that these are not, as a rule, stopped by the gas mask canister unless it has some very special treatment. The molecules of a gas move very rapidly within the gas itself, hundreds of yards per second, so that in passing through the charcoal and other ingredients of the canister, they strike against the chemicals and are absorbed. Molecules of smoke, on the other hand, move comparatively slowly, inches per second, and are drawn through the canister by the breathing man before they can attach themselves to the chemicals. In comparatively small amounts, toxic smokes cause sneezing and vomiting, thus forcing the removal of the old war time mask. In larger concentrations, pains of a serious character appear in the head and chest, and casualties are incapacitated for considerable periods of time. The American mask is designed to stop all such substances; but in the toxic smokes lies a great field for surprise attack by chemicals.

The fourth group are the so-called tear gases which affect the eyes and nose. Some of these are non-persistent; that is, they are borne away by the wind; but others contaminate the ground and objects on which they are lodged for long periods of time, thus forcing the wearing of gas masks. Tear gases would seem to have considerable use in naval warfare. Naval battles are of comparatively short duration, and a persistent tear gas spread over a ship will force the wearing of gas masks and very considerably hamper men in the execution of their duties. One part in 10,000,000 parts of air causes profuse tears or lachrymation. A man who gets a good dose of tear gas in his eyes cannot sight a weapon with accuracy for thirty minutes after getting out of the tear gas, and not at all while in the gas.

On the other hand, these gases have no lasting or harmful effects, and so are very suitable for use against mobs by police forces, in subduing criminals, and in prisons. Most of the penitentiaries, and many of the police forces and banks of the United States, are equipped with tear gas at the present time.

In addition to these casualty producing agents, chemical warfare includes non-toxic smokes of various kinds, and such substances as phosphorus, which is not only the best smoke producing material known, but an excellent casualty agent because of its burning qualities. Phosphorus, of course, burns on exposure to the air, and fired in shell against machine gun nests makes a tremendous weapon, since the burning particles are exceedingly difficult to extinguish.

All of these varied agents have possible naval uses; research and experimentation will develop their relative value.

All of the means of projecting gas and smoke by the Army find some possible naval counterpart, with the possible exception of the light 4.2-inch chemical mortar, a weapon capable of throwing large amounts of chemical agents to a distance of 2,500 yards, and yet itself so compact that it can easily be taken ashore in a dory. It might well be added to naval landing operation equipment.

In considering the present naval weapons, it is well to start with the most universal, and probably, all things considered, the most effective, artillery shells. Since it is generally the function of the shells from the ship's main battery to destroy the enemy's ships by penetrating into the interior of the vessels and exploding with such force as to destroy engines, interfere with ammunition supply, and affect in every way possible the handling of the ship, chemical agents alone do not satisfy naval conditions. It is a fact, however, that some twenty per cent of the cavity of a high explosive shell may be filled with a chemical agent without serious interference with its wrecking effect. We can expect that such may be the case in future naval engagements. In this connection, it is well to repeat that six pounds of a lachrymatory gas, properly dispersed, would be sufficient to cause lachrymation everywhere on board ship; or if a toxic agent were used, any penetrated compartments would be uninhabitable without protection. Chemical agents can be expected to work their way

with considerable rapidity throughout the vessel. The shell exploding on the side armor might, even if no material damage were caused, eject a chemical cloud which would be sucked in through the ventilating system.

It is true that the injection of a chemical agent into the high explosive magazine of a shell would increase the number and types of such shells unless some agent suitable for all purposes were adopted, hence this latter should be the line of naval development. Such a chemical should be quick acting and be unaffected detrimentally by the shell explosion. A 16-inch shell could carry some nine or ten pounds of such an agent. In the fields of toxic smokes and of persistent gases, such as mustard, are probably to be found suitable materials for such naval use. If the result was simply the forcing of the wearing of gas masks, it is unquestionable that some of the ship's fighting efficiency and the ability of its personnel to carry on, would be reduced.

Secondary battery shells have, as a rule, the function of preventing torpedo attacks from destroyers, submarines, and similar auxiliary craft. Although the amount of chemical agent in these shells is small, yet it should produce greater results comparatively than in the case of main battery shells because of the comparatively small size of the compartments and the lightness of construction of the craft which form the targets for such shells.

Shells filled entirely with chemical agents may have considerable use in naval operations other than ship-to-ship engagements. Phosphorus fillings offer special advantages for ship against shore firings and other special naval enterprises. Other types of smoke fillings, non-inflammable in themselves, could be used for the creation of smoke screens and the obscuring of landing parties where material damage was not desired.

Other than the ship's guns, it is probable that in future naval engagements the greatest material damage will be done by aircraft; and the statements as to the fillings of naval main battery shells apply with equal force to aircraft bombs, with the exception of bombs used solely for smoke producing purposes. However, it is sometimes possible for aircraft to carry and discharge a large number of small smoke bombs which, if loaded with high explosive, would produce no material effect on a battleship, but which if loaded with phosphorus might blind not only the antiaircraft armament but the main batteries as well. Tear gases could well be used in such bombs.

In addition to the bombing method of attack, we have developed in the Chemical Warfare Service various types of chemical curtains and screens to be laid by planes. From our first effective curtain produced from the comparatively slow moving bomber, we have progressed to a screen which can be dropped from the fastest moving pursuit plane. Since naval planes equipped with these devices have been operating with our fleets, it is probable that most naval officers are familiar with this highly spectacular war weapon. Present tanks permit the laying of effective screens, by one plane, a mile and one-half in length and 300 feet high in about fifty seconds. Such a screen is effective for some fifteen minutes depending on atmospheric conditions. Additional planes should be available to build up and maintain the screen. When these screens are composed of smoke, whole fleets can be obscured or a portion of the enemy's fleet blinded or cut off from vision of its other vessels. The addition to naval tactics here provided seems so great that a profound influence on naval engagements must result.

Airplanes may also lay a smoke screen with smoke bombs, and there has been devised for naval purposes a floating bomb of this type. Planes so equipped would have been valuable in the Zeebrugge operations to replace the more or less inefficient smoke provided by the burning of phosphorus on mine layers. This type of obscuring smoke presents many uses in the blinding of shore batteries. With planes so equipped, the British Navy might day after day have kept the Turkish forces at the Dardanelles in a man-made fog, facilitating greatly the necessary mine sweeping operations, and permitting close approach for the shelling of plotted shore batteries.

Planes carrying high explosive bombs may be forced by the antiaircraft guns of today to very considerable heights unless protected by extensive smoke screens, and only those bombs which make actual hits, or hits so close to the ship as to injure its structure, are of value. Furthermore, planes of very considerable size are neces-

sary to carry bombs of such weight as to do material damage.

With chemical bombs, however, light, small planes flying at great speed and in large numbers, can launch a great quantity of small smoke bombs, and hits are not essential. The initial cloud having been established, other planes can approach more closely to the ship or fleet until at last a condition is created which will protect the slow and somewhat unwieldy bombers in making their approach.

Successive smoke screens can be established in a similar way blanketing approaching high explosive bomb-carrying airships.

As I have said, hits with smoke bombs are not essential. They are, of course, highly desirable since a burning phosphorus bomb on the deck of a vessel will interfere very considerably with its gun fire.

A low smoke screen by whatever device emitted, is of particular value in hiding attacks by airplanes carrying torpedoes. As these planes have to fly within thirty feet of the water when dropping their torpedoes, in order that the gyroscopic mechanism controlling depth and direction will not be injured, a smoke screen two or three hundred feet in height would effectively conceal them from view from any part of the ship. The smoke screens for this purpose can be laid by high speed planes which will be exceedingly difficult to hit by any sort of antiaircraft or other fire. Once a plane carrying a torpedo has broken through the smoke curtain it can straighten its direction and launch its torpedo before there is any possibility of hitting it. Within the limits of success of the method of dropping torpedoes the smoke curtain would seem to make this one of the most powerful methods of attacking ships by airplanes.

The Navy has for years utilized the smoke funnels of destroyers for the purpose of creating smoke screens. The high temperatures of the stacks could easily be utilized for the dispersing of toxic smokes. The possibility of using smoke screens or clouds from floating smoke boxes and also from submarines has been considered. The submarine while vulnerable to gun fire could, with favorable winds, protect itself during smoke laying operations by its own smoke screen. The shallow draft of these vessels would permit close inshore operations, and they could very well be utilized for a discharge of toxic as well as screening smokes. The travel of a smoke cloud is probably not more than three or four miles under favorable weather conditions; but the means of attack indicated would have unquestioned value against coast fortifications.

In fact, it is against coast fortifications that chemical agents offer some of the greatest present advantages in naval operations. High explosive shell must make direct hits on guns and range finding apparatus on shore to be of any value. Fortifications drenched with mustard or even with persistent tear gas can be made untenable; and sufficient smoke clouds to make forts silent because unable to see anything during a run by, or during mine sweeping operations, might easily decide a ship against shore enterprise.

The possibilities of dropping curtains or screens of gas from airplanes through which ships or fleets may have to pass must not be overlooked. The difficulties in the establishment of such screens are technically few; but conditions of wind and weather would have to be considered as well as the comparative ease with which fleets and vessels can be maneuvered. It is, nevertheless, a fact that such an attack carefully planned on a large scale against ships equipped with present day ventilating systems and without gas protection, might have a very considerable chance of success. In this mode of attack, as well as in other forms of naval battle, one success is ordinarily enough to decide the question of naval supremacy throughout a war.

Marine landing parties usually operate against localities where reduction of loss of life is highly desirable. Smoke and tear gas provide means for such tactics. On the other hand, mustard gas can be made to float on the water in coves and other suitable landing points and offer a very serious menace to debarking forces.

Phosphorus shells and grenades are highly useful in landing operations and against the more or less untrained troops which can be expected to oppose such landings. Phosphorus proved its effectiveness in the World War against the highly disciplined German machine gun personnel. It is a particularly terrifying agent and would certainly be extremely effective against the hastily organized detachments which could be expected to oppose landing parties of our marines.

The problem of naval protection against chemical agents divides itself, as for the Army, into individual and collective protection. That is, there must be some personal protection for the man by means of gas masks and clothing more or less impervious to chemical agents, and there must be some method of keeping as much gas as possible out of the interior of the ship and off its decks. In addition to the gases which we may expect to have used in naval warfare as actual enemy agents, there is the problem of protection against carbon monoxide which may be released in some cases from the ship's own powder charges, and in others from the detonation of high explosive shells against or inside the ship.

Carbon monoxide is one of the deadliest of gases. Its lightness and extremely high pressure when liquified at ordinary temperatures, however, make it so difficult to adapt for field use that it was not included among the chemical agents developed during the World War. Nevertheless, the fact remains that a certain amount of carbon monoxide is released from all high explosive shells and caused many deaths during the war, both of men and animals. It is particularly dangerous in naval battles, since the explosion of shells often takes place in closed and semi-inclosed places. The German Navy had many casualties from carbon monoxide in their early engagements because their naval regulations provided for the discontinuance of the ventilating apparatus of their ships during action. By the time of the Battle of Jutland, all German naval personnel were equipped with gas masks.

It is of interest to note that the gunnery officer of the *Derfflinger** reports two instances of gas during this battle. It was necessary to abandon the heavy gun transmitting station and shift to "fore-control." A few seconds later, a heavy shell struck "fore-control" without penetrating, but "poisonous greenish-yellow gases poured through apertures into control," forcing the men to mask. He found it difficult to make himself understood, but the gases gradually dissipated and they "cautiously removed their masks." A later report indicated that the gases entered the transmitting station through the voice pipes from "Cæsar" turret, which was out of action. A petty officer, using a gas mask, reëntered the compartment, plugged the voice pipes, and the ventilators gradually removed the gases, permitting the control to be shifted back. The English, of course, were using only high explosive shells.

Defense against toxic chemicals aboard ship divides itself naturally into three phases: detection; protection during action; and eradication of the agents after action, or as soon as possible.

Although mechanical or chemical detectors can be devised, it is probable that the safest and most practical means of detection lies through some of our normal senses —sight, smell, or physical effect. This requires well trained personnel capable of recognizing the various chemical agents and able to initiate the necessary protective measures by prompt signal or report.

Both individual and collective protection must be utilized. Collective protection embraces all of those means which can be utilized to keep chemical agents out of the ship. A very considerable amount of thought has been put on this phase of the naval problem and the obvious answers are either sealed spaces with a regenerative air system, such as is used on submarines, and which can be put into operation during action, or some form of gas filter which can be inserted into the ventilating systems so that the ship's personnel will be breathing through what amounts to one or more huge masks. Every point of entry of air must be protected against gas including such insignificant inlets as voice pipes. This form of protection, however, will not prevent the entry of gas shot into the ship in the way of shells nor the retention of such agents as mustard by the highly absorbent wooden decks.

To insure safety, gas masks and protective clothing must be available for a very large portion of the ship's personnel. There is no question at the present time but that it is very difficult to provide protection against chemical agents on a ship; and naval constructors must in the future include this among their other problems.

A single type of gas mask will not answer all naval purposes. Ordinary masks will permit voice transmission; special optical masks must be made for use by the fire control group; and special submarine masks for protection against gases which may be generated by accident are necessary.

* *Kiel and Jutland*, Commander G. V. Hase.

Even with every possible mechanical device, the resistance of a ship to gas must depend on the state of the gas discipline of its personnel, and as in other important matters, training is the watchword for safety. Drill in the detection and identification of toxic gases, in demustardizing, and in cleaning up the ship after gas attacks, and in the proper use of the mask, itself, must be thorough. Fortunately, lachrymatory gases, both persistent and non-persistent, are available for the training of the ship's company in all these phases of gas protection. Mechanical or chemical indicators will be necessary in addition, since because of what we term "nasal fatigue," the sense of smell fails as an indicator for mustard gas, and the nose will not detect low concentrations which may be exceedingly dangerous from their cumulative effect. Neither is the nose reliable against fake gases.

The problem of permanent eradication of chemical agents after an attack is a very difficult one on shipboard. Mustard gas and gases of a similar type are very slowly soluble in water, and when absorbed by wooden decks, present serious problems even for thoroughly trained clean-up squads; even army commanders in the World War found it easier to remove troops from a mustardized area than to attempt to restore such an area to a tenable condition. Only the method of cleaning up the ship is available for naval commanders.

A battle at sea is warfare in which momentary advantages of position and momentary superiority of fire are of the utmost importance. In achieving these, or in preventing the enemy from obtaining them, gas and smoke offer powerful auxiliaries to the more usual naval weapons. The navy that excels in these, if otherwise equal to the enemy, will win.

A Brief *for the* Submarine

By MIDSHIPMAN (NOW ENSIGN) ALBERT C. BURROWS, *U. S. Navy*

EDITOR'S NOTE: This article was adjudged the winner for 1928 of the gold watch presented by Dr. Henry van Dyke to the member of the graduating class who submits the best original article or theme on any naval or equally patriotic subject.

SHALL we destroy while we build? Shall we extend our Navy in one direction, only to curtail it in another? These questions, as a result of the proposal to abolish the submarine, now confront those who determine the policy of our Navy both today and tomorrow. There are those who would appropriate for and build cruisers, destroyers, dirigibles, and other component parts of the fleet while at the same time depriving it of a most vital unit —the submarine. Why?

The beginning was a public hysteria, born of four years of flaming headlines, "Torpedoed Without Warning"; a hysteria which brought many to look upon the submarine as a man-made shark and its crew as embodying all that is cowardly, cruel, and treacherous. Revived and augmented by recent disasters to underwater craft, this hysteria has blinded people to the innumerable merits of the submarine and has brought them to look upon it as a work of Frankenstein—to be destroyed without delay.

A moment's reflection will serve to show the fallacy of such a position. Granted that submersibles were employed illegitimately in the past conflict, when they were directed against non-combatants, who is there to say that it was the fault of the submarine? A vessel is no better than the crew which mans her. Imagine the stately *Constitution* manned by Blackbeard and four hundred of his cutthroat cohorts—truly we would have a sea scourge! It is generally contended that War is the servant, Policy the mistress. If the policy be one of fiendish disregard for the rights of neutrals, women, and children, then war will be waged to that end—weapons being but the tools of war. Almost daily we are told of the havoc which might be wrought by a fleet of hostile airplanes attacking our defenseless homes; how war would be brought to each and every one of us—soldier and infant alike. The employment of submarines against harmless non-combatants was, it is true, one of the reasons which caused our entry into the war, but now this identical employment is foretold for aircraft! Yet, there are none who would tell us to abolish the airplane.

The mission of the Navy, in war, is the destruction of the enemy's fleet. Each type of ship is so designed and constructed that she may be enabled to destroy while she herself remains unharmed—or at the most suffers a minimum from hostilities. The dreadnought is heavily armed and armored; the cruiser possesses great speed; while the submarine seeks protection by submerging. It is merely a substitution of a few fathoms of water for a few inches of armor plate, or high speed. She is the logical result of a process in naval development—that of embodying the tactical principle of surprise in a war vessel. True, she makes use of this inherent feature in ambuscade—but in war ambuscade is always legal!

Let us consider the merits and uses of the submarine. The modern underwater craft, while far from perfect, compares most favorably with the surface vessel in the combined qualities of speed, cruising radius, and armament. Marley F. Hay, noted submarine designer and authority, stated recently:

> It may be surprising to learn that in point of armament, radius of action, and seaworthiness, a modern submarine already considerably surpasses any destroyer of equal size.

The submarine is far superior to any *single* type as regards versatility in operation. What other type of vessel can be so advantageously employed in the myriad duties of scouts and advance guards; for pro-

tection of trade routes and naval bases; for attacks unsupported by surface ships on moving fleets and convoys; for forcing the passage of straits and channels; for carrying information and dispatches; and guarding lines of communication? All of these have been accomplished by the submarine —a type relatively in its infancy!

For proof of the efficacy of the submarine, one need only recall that nearly fifteen hundred armed vessels were required to patrol the largest mine field ever laid down in naval warfare to limit the activities of 100 to 150 "U-boats," issuing from their only bases on the German and Flanders coasts. And again, within three hours after the declaration of war between England and Germany, the submarines of the former were reconnoitering in Heligoland Bight. Underwater craft of the British penetrated the defenses of the Dardanelles—defenses which were almost impregnable to surface craft—and operated in the Sea of Marmara. It is interesting to note, at this point, the rôle played by the submarines of both sides in the action off Heligoland Bight, August 28, 1914. Winston Churchill, then first lord of the Admiralty, made the following statement:

> The successful cruiser operations were due to the information brought to the Admiralty by scouting submarines.

Domville-Fife, in his *Submarines and Sea Power*, says of the same action:

> In the cruiser action off Heligoland, the inferior German squadron was covered by a flotilla of submarines, and, at the moment when the powerful British battle and light cruisers had triumphed over the enemy and were attempting pursuit to complete their victory, the German submarines, by a vigorous offensive, and aided greatly by the presence of mine fields, caused Admiral Beatty to order the discontinuance of the action owing to the great risk to which he would have exposed his big ships had the attack been pressed to what otherwise would have been an annihilating conclusion.

Not only in this instance, but at Dogger Bank and elsewhere was it the submarine that saved surface craft from complete destruction. Even at Jutland, Jellicoe and Beatty always bore clearly in mind the risks from submarines. As to its scouting value, successful and unopposed raids made by German cruisers on Scarborough and Hartlepool were largely the result of information furnished by submarines. The necessary information as to the movement of the British Grand Fleet was made known to the German authorities solely through the activities of their submarines.

As regards the efficiency of submarines, operating against blockades, it may be worthy to note that, in addition to furnishing information and undertaking auxiliary operations, German submarines continued to be a menace up to the close of the war—long after the German cruiser raiders had been destroyed and operations by their surface craft were impossible. This in spite of mine and patrol. In fact, the best defense against submarines was found to be *submarines*. Admiral Sims, in *The Victory at Sea*, points out that in proportion to the number of antisubmarine craft employed, the Allied submarines destroyed three times as many German subsurface craft as Allied destroyers and twenty times as many as auxiliary patrol craft.

At the present time, it is perhaps inopportune to prophecy, but there can be no doubt that the feat of the cargo carrying *Deutschland*, which successfully ran the cordon thrown about passages leading to America, marks but the beginning of a new era of war time merchant shipping. The advantages of the submarine as a blockade running merchantman are at once apparent. Thus we can say that the submarine has met successfully every test; that it has proved its worth not only in one but in many phases of naval operations. It is obvious, therefore, that to deprive our Navy of the advantages of such a type of craft would be at least seriously crippling.

Not only would abolition of the submarine impair the fighting efficiency of our Navy—the point in which we are primarily concerned—but it applies none the less pertinently to the navy of the lesser nation. The submarine as the weapon of the smaller nation is a point of real significance to the United States. We have ever championed the cause of the lesser nations in their rights of self-defense. Such nations cannot afford sea protection of the order of the great powers, but protection is, nevertheless, required. Yet there are those who, in the scrapping of the submersible, would deprive them of that most effective and economical means of defense.

That naval authorities are not unmindful of the utility of the submarine is adequately proved by the position taken by Admiral

Beatty in his dispatch to the British Admiralty concerning the result of the cruiser action off Dogger Bank, in January, 1915. Naval authorities, from this report, drew these three conclusions: that gun fire was not adequate submarine defense; that safety lay only in utilizing the maneuverability of the surface craft; and, finally, that surface ships should, in the event of attack by underwater craft, turn away at once and steam out of range. Imagine the confusion which would be wrought by a sizable flotilla of submarines in such an attack! Formations broken; communications impaired; coöperation between the various units utterly destroyed—each ship, or at best, each division turning away in order that they might remain intact. The opposing surface fleet need only cover the rout caused by the underwater advance guard and take up an advantageous central position. War remains a "business of positions" today as in the time of Mahan, and there is no more economical medium of exchange than the submarine in the purchasing of the tactically superior position. There is, moreover, need of a new definition of superiority when submarines are employed. A surface fleet, inferior in type and number to an opposing force, but possessing sufficient submarines, well used, may, at the decisive moment, convert its inferiority into superiority.

If a decade ago the submarines could have accomplished and performed so well the tasks assigned them of which a few isolated examples have been set forth, how much more could they do today and what infinitely greater power will they have tomorrow? For we have made but a beginning. Submersibles mounting guns of large caliber have been successfully designed and built. Compare, in this light, the bombardment of Whitehaven by the submarines of the World War, carrying 28-pounders, to the destruction which could be wrought by a shelling from 8- or 12-inch guns. Submarines have been built carrying such weapons; it is true, they were not an unqualified success, but it has been shown that the mounting of such guns on vessels of this type is more than a structural possibility. Submarines are becoming—if not submersible dreadnoughts—at least underwater cruisers. Our own highly successful "V" type is more than a match for a destroyer even while operating as a surface vessel. It is not beyond the realm of probability, then, that in a short time we shall be building an underwater craft which will be able to stand off as much as a division of destroyers with her guns alone, while conserving her torpedoes for attacks on heavier armed vessels. Such a craft would not have to dive to seek protection from a light cruiser; her gun fire would suffice. Combine, then, her heavy armament with the peculiar advantages of her construction, and we have indeed a worthy weapon. Such types are long past the stage of possibility, or even of anticipation; they are the submarines of a very near tomorrow. Truly, the *Nautilus* of Jules Verne is becoming an actuality.

We, as a nation, have never attempted to outstrip the world in the building of our Navy. We have not strained our resources in the building and equipping of a vast, all-powerful naval force. We have, on the contrary, been content with a fleet which is barely sufficient for our needs. America has, many times in her history, been represented on the ocean highways by a fleet far below the level of adequacy. That we were not content with such a fleet is most positively shown by the attitude of the American people toward an adequate naval force. Yet, submarines are an indispensable arm of our Navy.

As American citizens we should be proud of our Navy, should support it, and be jealous of its prestige; and we should want it to be the leader in naval progress. We want to feel—and rightly so—that our sailors are as fine, our battleships as powerful, our cruisers as swift, as those of any navy in the world. Among the things that "ought to be," that we should want to be, is a submarine force second to none. For we shall need submarines to scout where cruisers cannot go, we shall need them to supplement the mine defenses of our harbors, we shall need them to operate against enemy submersibles, and we may need them to carry our cargoes safe from hostile vessels. It behooves us, therefore, to retain what we have and develop it as best we may. The submarine is an American invention. It belongs to America along with the airplane, the steamship, and the telegraph. It is ours to keep, to improve, to perfect and to use—but not to misuse.

Scraps *from* Old Sea Bags

By WILLIAM E. BEARD

RECRUITING ABOARD THE OLD *Jersey*

EBENEZER FOX, a New Englander as his given name would suggest, went a-sailing at seventeen in the twenty-gun ship *Protector*, which had been built and fitted out by Massachusetts to protect commerce and annoy the British during the Revolution. Fox had been born in Roxbury, Massachusetts, January 30, 1763. At the age of seventy-five he committed his Revolutionary War adventures to paper. These experiences thus perpetuated, included not only some exciting encounters upon the high seas, but also a stay of long duration in the British prison ship, the old *Jersey*, and finally a narrow escape from being impressed for service by the Comte de Grasse's fleet just before the disastrous engagement with Admiral Rodney.

Scanty and unwholesome food, foul water drawn up from beside the rotting hulk stuck hard and fast in the mud of Long Island, impure air, close contact with disease and death, and hopeless captivity—for there was no possibility of exchange—were some of the hardships endured by the inmates aboard the old prison ship. Another discomfort, and no trifling one, was the vermin with which the ship was abundantly infested. What to do with the vile pests was one of the minor problems of the unfortunate prisoners, for catching them was the easiest of tasks. According to Fox, a general consultation among the prisoners was held and it was decided to deprive the pests of their liberty. A large snuff-box was appropriated for the purpose of confining the vermin, and the prisoners proceeded to find some amusement in making contributions. The snuff-box was inhabited by thousands of various varieties of vermin, awaiting the decision of the prisoners as to their disposition. Fox says:

> British recruiting officers frequently came on board, and held out to the prisoners tempting offers to enlist in his Majesty's service; not to fight against their own country, but to perform garrison duty in the island of Jamaica.
>
> One day, an Irish officer came on board for this purpose and, not meeting with much success among the prisoners who happened to be upon deck, he descended below to repeat his offers. He was a remarkably tall man and was obliged to stoop as he passed along between the decks. The prisoners were disposed for a frolic, and kept the officer in their company for some time, flattering him with expectations, till he discovered their insincerity, and left them in no very pleasant humor. As he passed along bending his body, and bringing his broad shoulders to nearly a horizontal position, the idea occurred to our minds to furnish him with some recruits from the colony in the snuff-box. A favorable opportunity presented, the cover of the box was removed, and the whole contents discharged upon the redcoated back of the officer. Three cheers from the prisoners followed the migration, and the officer ascended to the deck, unconscious of the number and variety of recruits he had obtained without the formality of an enlistment. The captain of the ship (a Scotchman), suspicious from the noise below, that some joke had been practiced or some mischief perpetrated, met the officer at the head of the gangway and, seeing the vermin crawling up his shoulders and aiming at his head with the instinct peculiar to them, exclaimed, "Hoot, mon, wha' is the matter with yer bock?"

Confinement below with shorter allowances of food was the price paid by the prisoners for their joke.

BARNEY'S FIGHT WITH THE *General Monk*

One of the names of other days which is still familiar is that of Joshua Barney, a Maryland contribution to American naval history, who as a lad served under Commodore Hopkins and, as a veteran, fought in defense of Washington City in 1814. The scene of one of his intervening exploits was Delaware Bay where, on April 8, 1782, as commander of the *Hyder-Ally*, he saved his convoy of merchant vessels and captured the British ship *General Monk*, Captain Josiah Rogers.

The *Hyder-Ally*, mounting sixteen 6-pounder guns, had just been fitted out by

the State of Pennsylvania to protect the commerce of Philadelphia from depredations committed in Delaware River and Bay by the armed ships of England and picaroon privateers fitted out in New York. Command of the ship was offered to young Barney, lately returned for a visit to his family. The action took place at the entrance of Delaware Bay, with two other British ships, one a frigate, near the scene. The *Monk*, mounting twenty 9-pounders and manned by one hundred and thirty-six men—twenty-six more than the *Hyder-Ally*, struck her colors after a terrific fight of twenty-six minutes, during which she sustained a loss of twenty killed and thirty-three wounded. Pennsylvania bought the prize, her name was changed to the *General Washington*, and Barney was commissioned her new commander. Pennsylvania also presented the daring young seaman a sword, which, in 1794 was stolen from his rooms in Paris while he and other Americans were participating in the ceremony of depositing the ashes of Jean Jacques Rousseau in the Pantheon. Later, while in the naval service of the French Republic, Barney had a picture painted in Paris of the fight with the *General Monk*. On his return to the United States, this was presented by him to Robert Smith, Secretary of the Navy, in whose office the painting was hung.

The Crown Prince of the Sandwich Islands

On August 10, 1790, the ship *Columbia*, Captain Robert Gray, reached Boston, her home port, after an absence of nearly three years, during which she had carried the American flag around the world. Present in Boston the memorable afternoon of the ship's return was a fifteen year old lad from Worcester, E. S. Thomas, a nephew of Isaiah Thomas, the founder of various Massachusetts publications and author of the *History of Printing*. The young man, himself, later became an editor; first in Charleston, South Carolina, and later in Cincinnati, in 1840 publishing his *Reminiscences of the Last Sixty-five Years*.

According to this authority, the *Columbia* on her home bound voyage had called at different clusters of islands in the South Seas, among others, the Sandwich Islands, where, as elsewhere, the visiting seamen had met with friendly attentions from the natives. This was particularly true at Owyhee where the king of the Sandwich Islands resided. Such was the high regard and confidence entertained by the Sandwich Islanders for Captain Gray that they permitted him to carry the "Crown Prince" off with him for a visit to Boston.

In the summer of 1790 [says the Thomas *Reminiscences*], in a fine afternoon, I had just arrived in Boston, from Worcester, when a strange ship, bearing the Stars and Stripes of our country, arrived abreast of the castle, and fired a national salute, which was promptly returned by that fortress. The firing was distinctly heard and seen from Boston, but no one could imagine what ship it was, bearing our country's flag, and doing and receiving such high honor. The inhabitants were all in motion, and going to the long wharf by thousands; in the interim, the ship was recognized and the artillery were ordered out. As she came to anchor off the end of the wharf, the delighted multitude rent the air with joyful acclamations, while salvos of artillery shook the neighboring hills, and the astonished people hurried into the city to join in the general joy.

The ship having returned the salute of the city, the custom house barge was manned, when the venerable General Lincoln, collector of the port, with the owners of the *Columbia*, repaired on board, and after bidding a hearty welcome to Captain Gray and his princely passenger, they all returned to the wharf together, when the air again rung with loud acclaim, and the artillery again poured forth its thunder. The prince, who was an Apollo in personal symmetry and beauty, was dressed in a helmet of the ancient Roman form, covered with small feathers of the most beautiful plumage, which glittered in the sun, while on his body he wore a close dress, not visible, except the sleeve, and over it a large and flowing robe in the form of the toga, made of cloth, covered with feathers precisely like the helmet. In this splendid costume, he took the arm of Captain Gray, and a procession being formed, they marched to Governor Hancock's who had sent his adjutant-general Donaldson to bid them welcome. After a residence of some months, the ship was refitted, and with the same commander returned the prince in safety to his country and his friends; from thence sprung all that friendly intercourse between those happy islanders and the United States.

It was after his return to the northwest coast of America that Captain Gray, on May 11, 1792, discovered the great river to which he gave the name of his ship.

The Naming of Ships of the Navy

The following resolution received the approval of President James Monroe on March 3, 1819:

Resolved, by the Senate and House of Representatives of the United States of America, in Congress assembled, that all the ships of the navy of the United States, now building or hereafter

to be built, shall be named by the Secretary of the Navy under the direction of the President of the United States, according to the following rule, to wit: those of the first class shall be called after the states of this Union; those of the second class, after the rivers; and those of the third class, after the principal cities and towns, taking care that no two vessels in the navy shall bear the same name.

Proceeding under this plan, navy commissioners on May 25, 1820, selected by lot a name for a ship of the line then nearing completion in New York. The first State having the distinction of giving her name to a ship of the line, as thus provided, was Ohio. The vessel was launched five days afterwards, on May 30.

The U. S. ship of the line, *Ohio* [says a contemporary account], was launched at New York, on Tuesday last in the presence, it is supposed, of nearly one hundred thousand persons, amidst discharges of artillery from the *Washington*-74 and sloop *Hornet*, which were answered by a battalion of artillery. She glided into the water in a majestic style, and no accident occurred. She is a vessel of the first class, built of the best materials and with great care, by Mr. Eckford.

Admiral Paulding's Ball

An interesting commentary on the feeling entertained in Europe for the United States and the country's representatives, following the continuous succession of victories in Mexico, is an old letter written by the late Rear Admiral Hiram Paulding, then commanding the U. S. frigate *St. Lawrence* in European waters, to John Y. Mason, Secretary of the Navy. The letter reads:

(Unofficial) U. S. Frigate *St. Lawrence*,
Southampton, January 3, 1849.

Sir:

I am at a loss to think what may be the opinion of the Department and the President of our festivities here.

The course I have pursued seemed to me the best and I hope may meet with the approbation of the government.

As in Germany, I cannot convey to you in ordinary language the feeling of interest and kindness that we have universally met with. As an incident I hope you will excuse me for mentioning that at our ball there were many small American flags as decorations to the supper table, every one of which were appropriated by the ladies, for the last of the evening, and worn in their hair or girdle.

A number of gentlemen of importance in this community remained in the supper room after the ladies had retired to the ballroom and several said to me in a low tone, "I am a republican." One gentleman, that said this to me, is a correspondent and friend of Mr. Cobden, a man of ability and the editor of a paper. He came to me and said, "I am a republican; your nation is the greatest in the world; we have no such men in England as your statesmen. There is not a man in England equal to your President. No man in England can produce such a state paper as his message to Congress." My American feeling was in the ascendant; my heart was full and fearing he might be overheard and our harmony interrupted, I could only say to him, "We cannot now speak of this."

When I had determined to give a ball, I made up my mind to do it handsomely. It has cost upwards of a thousand dollars which as I informed you I should do, I have caused to be charged to the Government. It was in fact, under the circumstances, an unavoidable expense.

It must and, I trust, will be considered that my situation is a peculiar one and the light in which I regard my public duty necessarily involves such expenditure.

If in this I misapprehend what is considered proper, I hope the Department will guide me in future by its admonition and if otherwise that I may receive its sanction to exercise a proper discretion in the return of public hospitalities. On this subject it will be painful to me and perhaps prejudicial to the public interest to be in doubt. I have no object or wish than to discharge my duty in a manner satisfactory to the government and with the highest credit to our country.

I had the honor sometime since to send to your address a paper reporting the "Banquet" given to us here and with this send two papers, one reporting the public dinner given by Mr. Croskey, our consul, and the other our ball.

I shall sail today for Lisbon and have the honor to be very Resp'y Sir,

Your ob'd't serv't,

H. Paulding,
Captain

Secretary Mason sent the letter of Captain Paulding to Mrs. Polk, the wife of the President, after making the following indorsement upon its cover: "Respectfully referred to Mrs. Polk for her consideration. Relating in some degree to the conduct of foreign ladies in reference to the Stars and Stripes, the paper is placed at her disposal.

J. Y. M."

The letter is preserved among the Polk papers in the hands of descendants of Mrs. Polk's household.

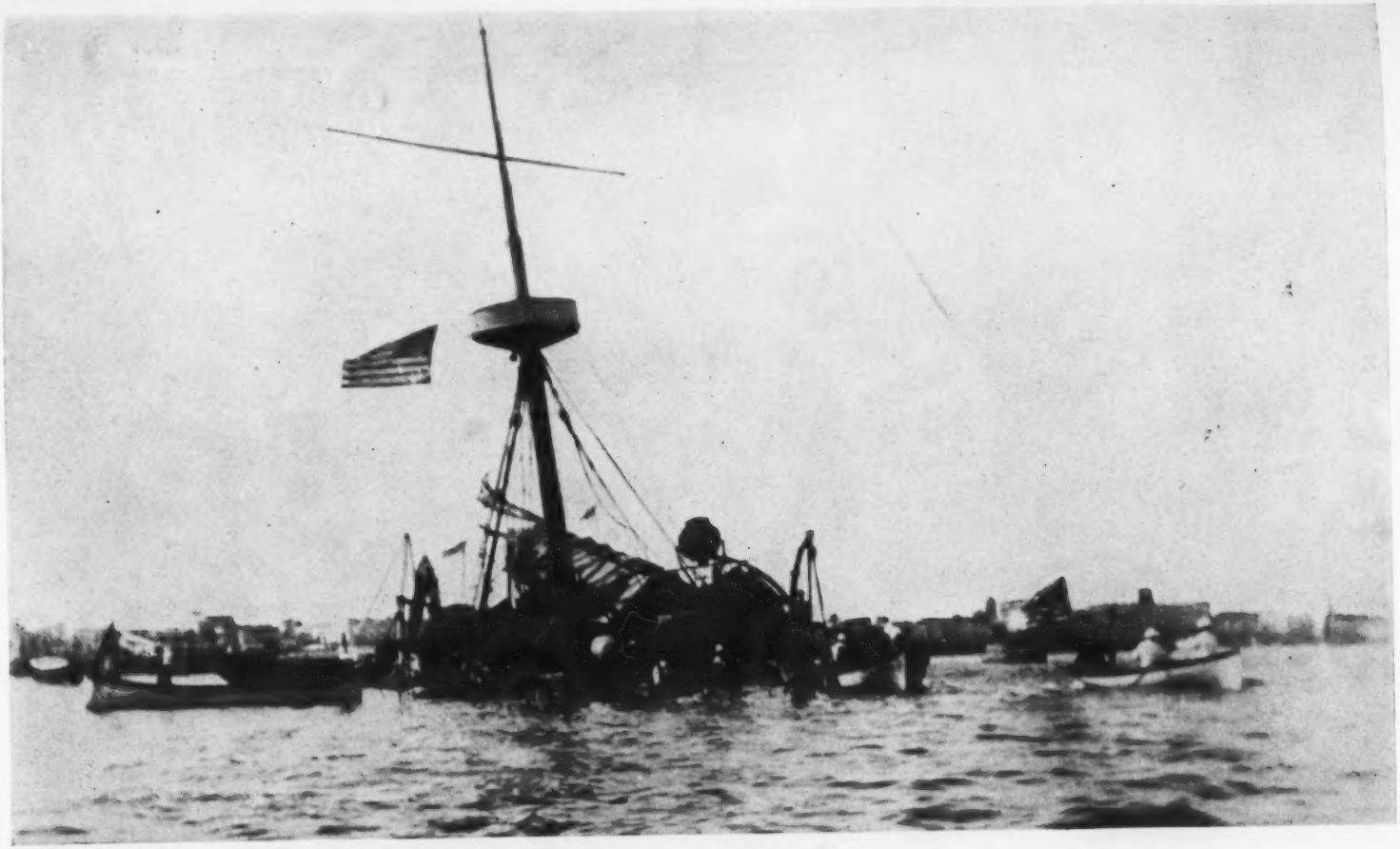
Washington's Birthday Under Two Flags

On January 12, 1861, commissioners representing the State of Florida, and accompanied by troops from that State and from Alabama, took possession of the Pensacola navy yard and the works in the vicinity, excepting Fort Pickens, into which the U. S. troops had been moved two days before in anticipation of such a movement.

On January 13, Colonel W. H. Chase, aid-de-camp to the governor of Florida, and colonel commanding, ordered a new flag hoisted at the navy yard, forts, barracks and hospital in the harbor in possession of the state troops, to succeed the United States flag which had been hauled down on January 12. "Until otherwise ordained by the people of Florida, assembled in convention, the emblems of the flag will be thirteen stripes, alternate red and white, commencing with the red, a blue field with a large white star in the center," the order reads.

There ensued a period of "watchful waiting" in the course of which the U.S.S. *Wyandotte,* Lieutenant O. H. Berryman, in the harbor at the time of the seizure, was joined by the frigate *Sabine* and the sloops *Brooklyn* and *St. Louis.* Such was the situation when Washington's birthday came. At Fort Pickens was a correspondent of *Harper's Weekly* who recorded an interesting occurrence of the day, the firing of salutes by the hostile forces in commemoration of the Father of his Country:

> At noon on the twenty-second some secession guns in the navy-yard, to the right of the hospital, most unexpectedly to us opened a salute; soon after a puff of smoke rolled up from Fort Barrancas, and hid their flag of one star and many stripes, and they were hardly fairly at it before Berryman's port showed a lightning flash, and column of smoke shooting out, paused an instant, rose, and then the breeze striking it in the center, bore it to leeward in an N-like shape over the vessel, while a beautiful ring hung for a moment over the flag at the main then melted softly away, while one could hear exclamations of delight from our men on the ramparts. It was a grand, pleasing but withal melancholy sight; these white puffs of smoke shrouding different flags, and yet honoring one man.
>
> Looking seaward, we saw the *Brooklyn* and *St. Louis* close together, wrapped in a cloud of smoke, while the rapid, spiteful discharges brought most vividly to mind one's idea of a naval battle. The *Sabine* was further off, pounding away majestically by herself, which I think she is well able to do. After all was silent, and the eyes of friend and foe were turned to Fort Pickens, a long thirty-two opened seaward, and then the salute ran from gun to gun around the whole parapet, and thus ended the twenty-second in Pensacola harbor.



International Newsreel

WRECK OF THE *MAINE* IN HAVANA HARBOR

The straw that broke the camel's back. After years of controversy with Spain over affairs in Cuba, the sinking of the *Maine* brought on war.

International Newsreel

FUNERAL OF THE VICTIMS OF THE *MAINE* PASSING THROUGH THE STREETS OF HAVANA

International Newsreel

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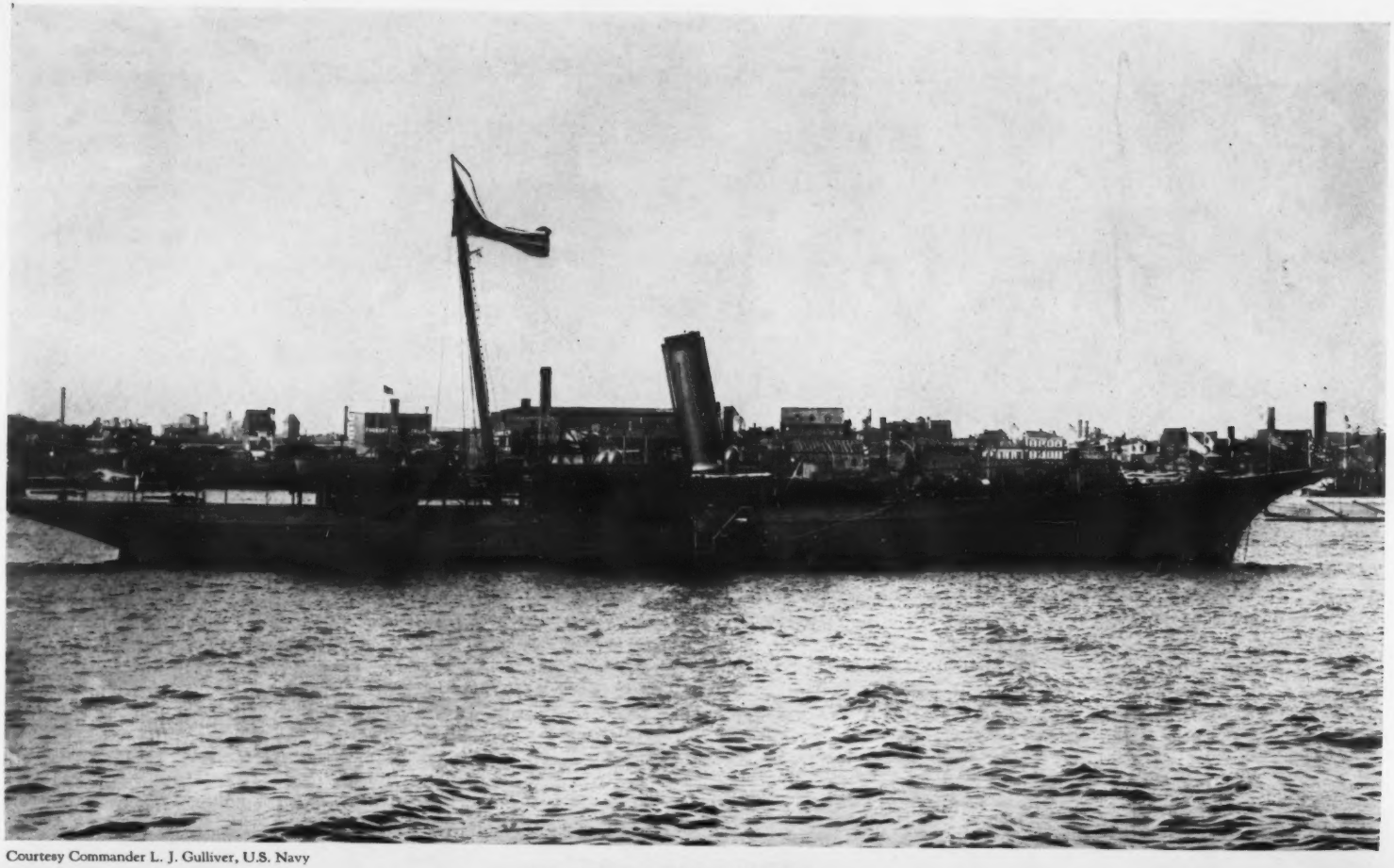
International Newsreel

COURT OF INQUIRY, INVESTIGATING THE SINKING OF THE *MAINE*



Courtesy Commander L. J. Gulliver, U.S. Navy

U.S.S. *GLOUCESTER* IN WAR TRIM
(See article, "The *Gloucester* at Santiago," in this issue.)

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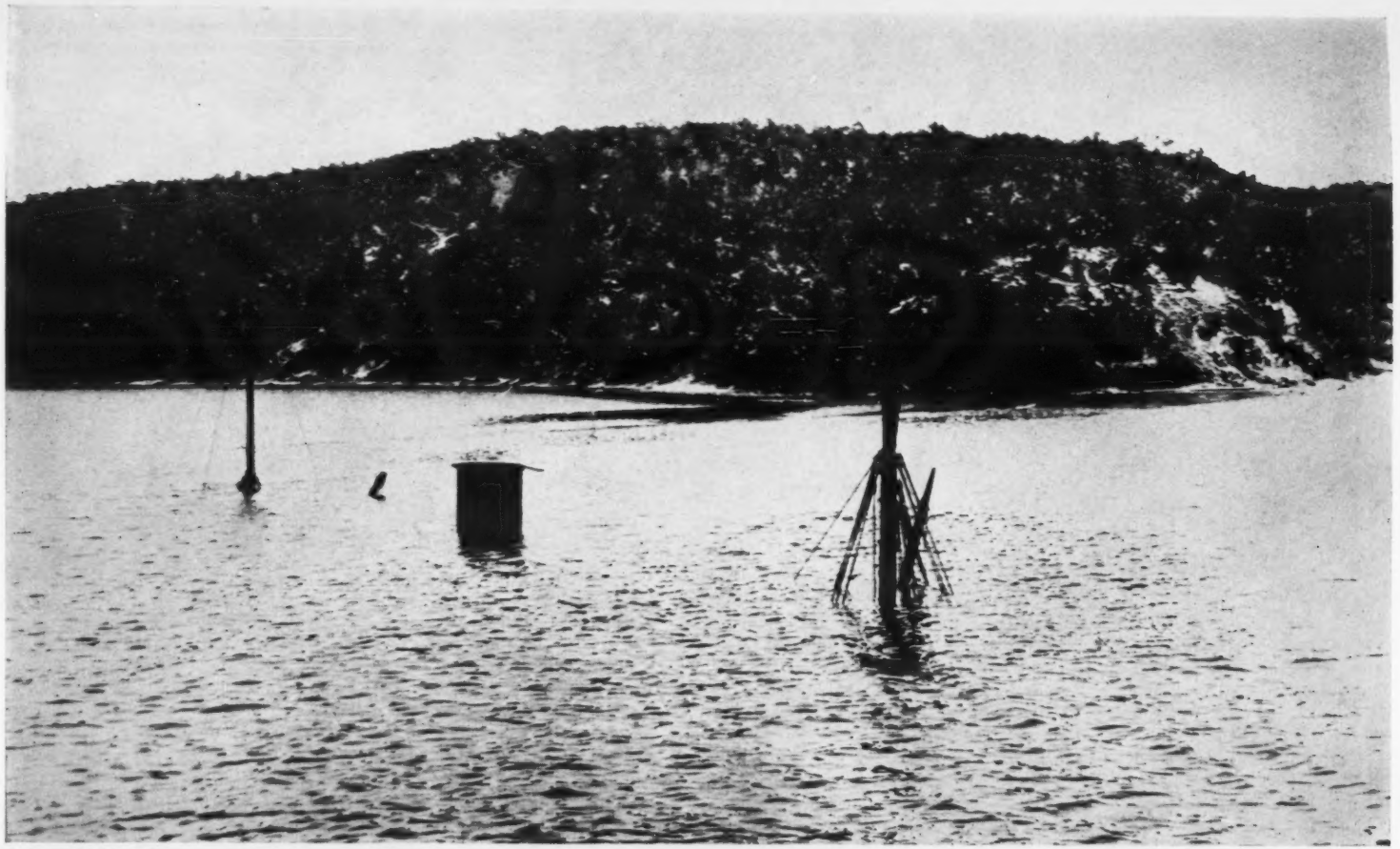
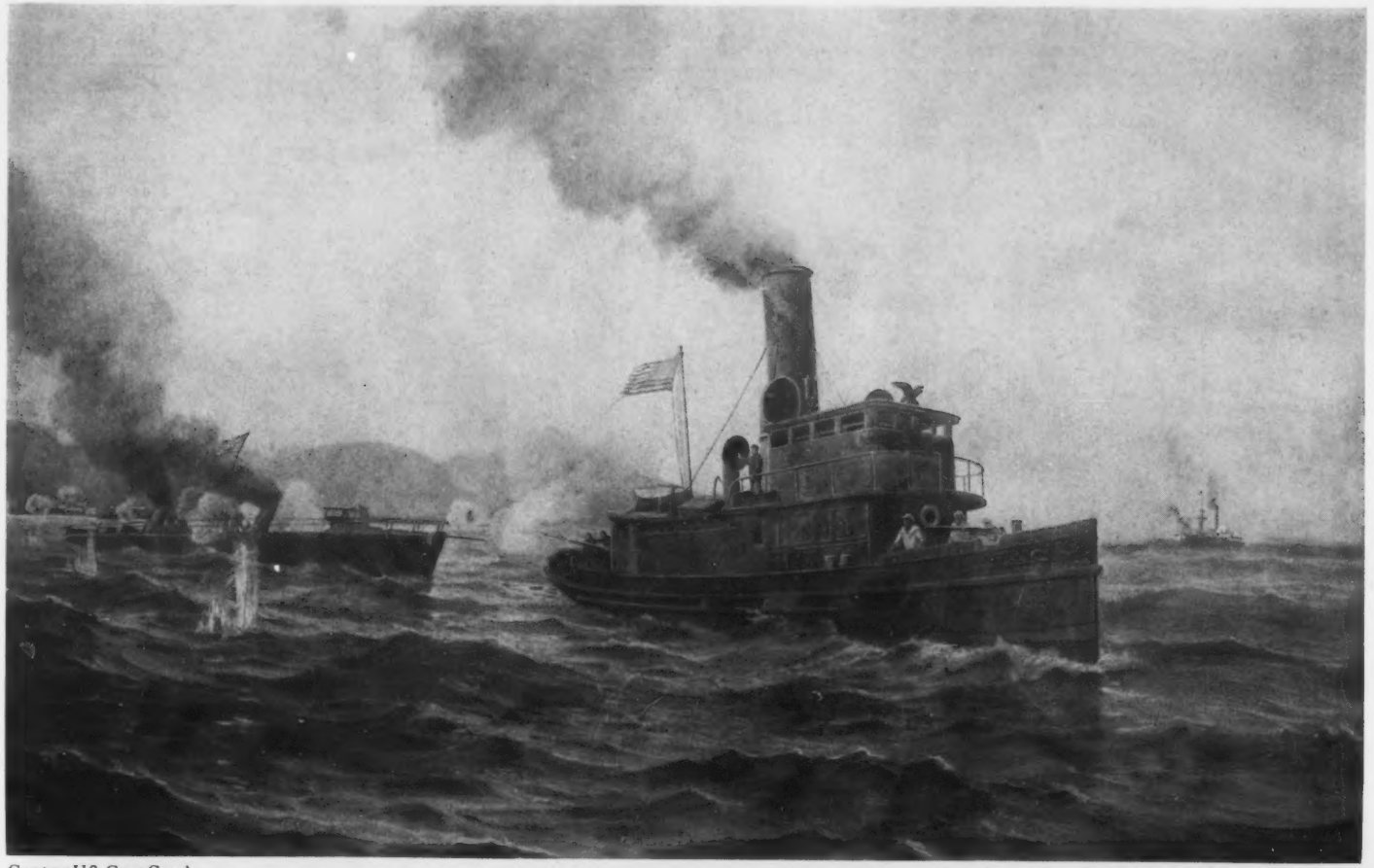


International Newsreel

WRECK OF THE *MERRIMAC*
Sunk in the entrance to the harbor of Santiago, Cuba, in an effort to bottle up the Spanish fleet, anchored inside.



Courtesy U.S. Coast Guard

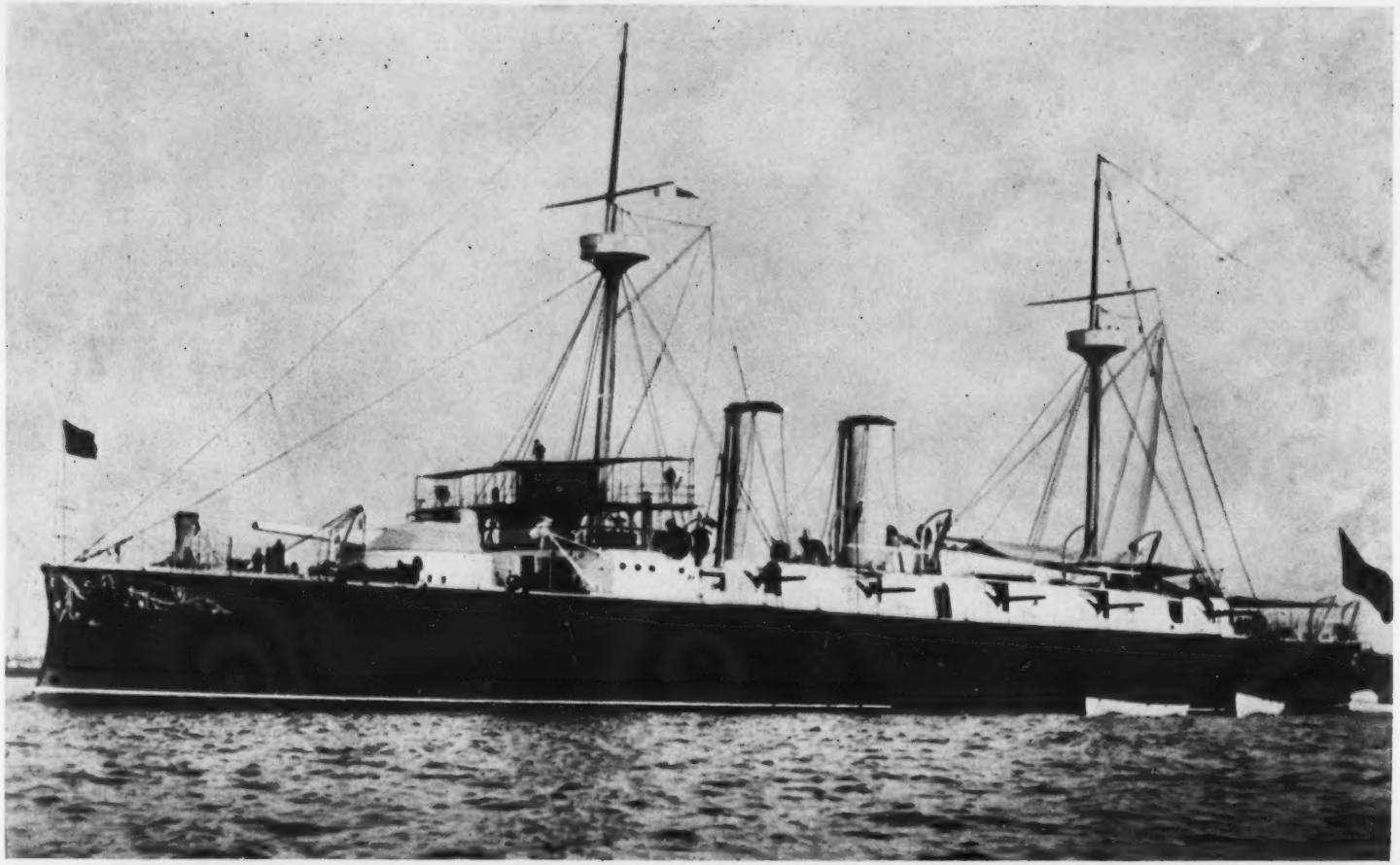
COAST GUARD CUTTER *HUDSON* RESCUING THE DISABLED TORPEDO BOAT *WINSLOW* FROM UNDER THE BATTERIES AT CARDENAS, CUBA, MAY 11, 1898
In recognition of this gallant action, Congress authorized a gold medal for the commanding officer, silver medals for each of the officers and a bronze medal for each member of the crew of the *Hudson*.

Cou

Courtesy Lieutenant H. A. Gosnell, U.S.N.R.

REAR ADMIRAL PASCUAL CERVERA y TOPETE
Commanding the Spanish squadron despatched to the West Indies in 1898.

In recognition of this gallant action, Congress authorized a gold medal for the commanding officer, silver medals for each of the officers and a bronze medal for each member of the crew of the *Hudson*.



Courtesy Lieutenant H. A. Gosnell, U.S.N.R.

ARMORED CRUISER *INFANTA MARIA TERESA*

Flagship of Admiral Cervera at the battle of Santiago de Cuba. 7,000 tons, mounting two 11-inch, ten 5-inch, eight 2.2-inch, eight 1.4-inch, two machine guns and six torpedo tubes. Speed 20.5 knots. Spanish built.

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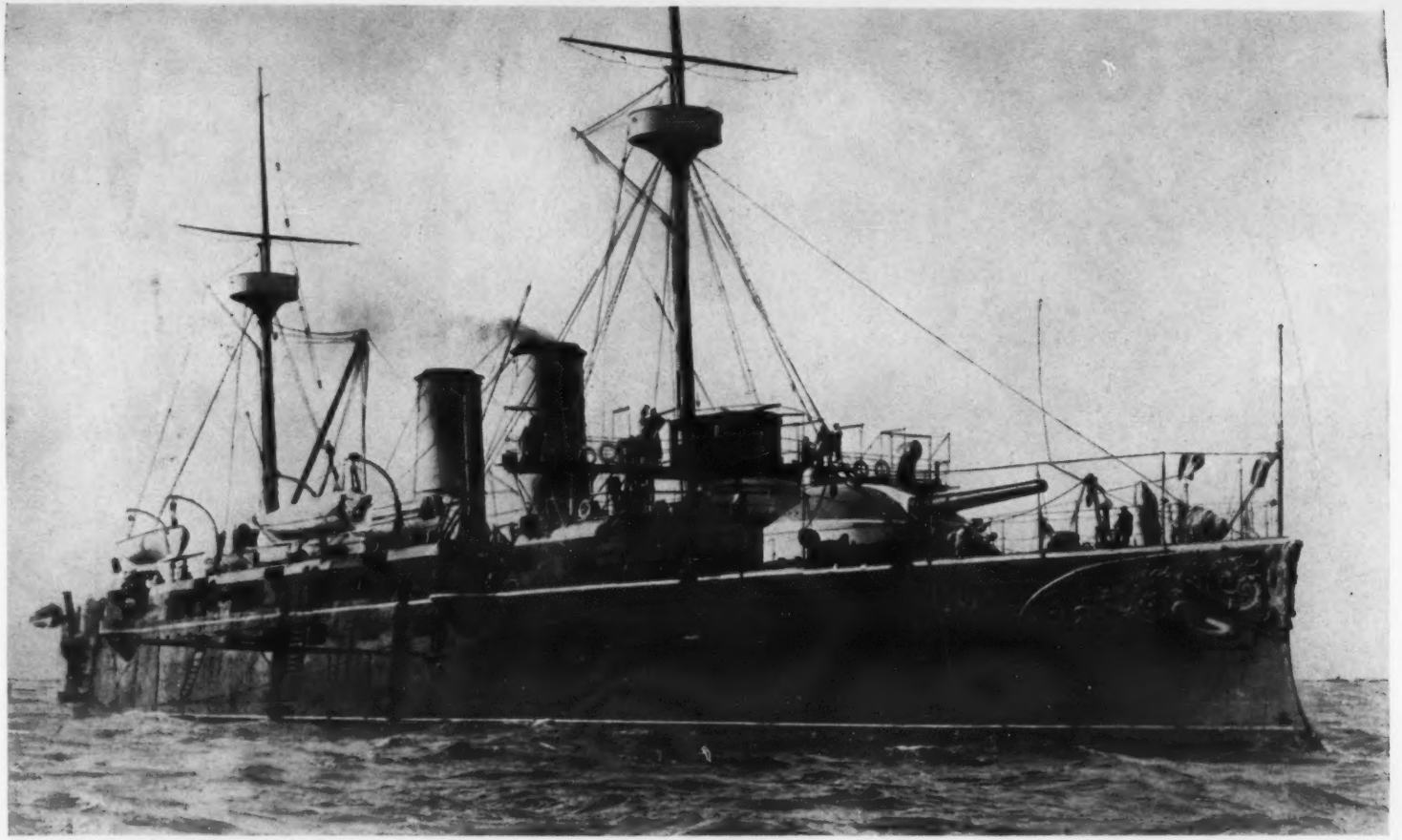
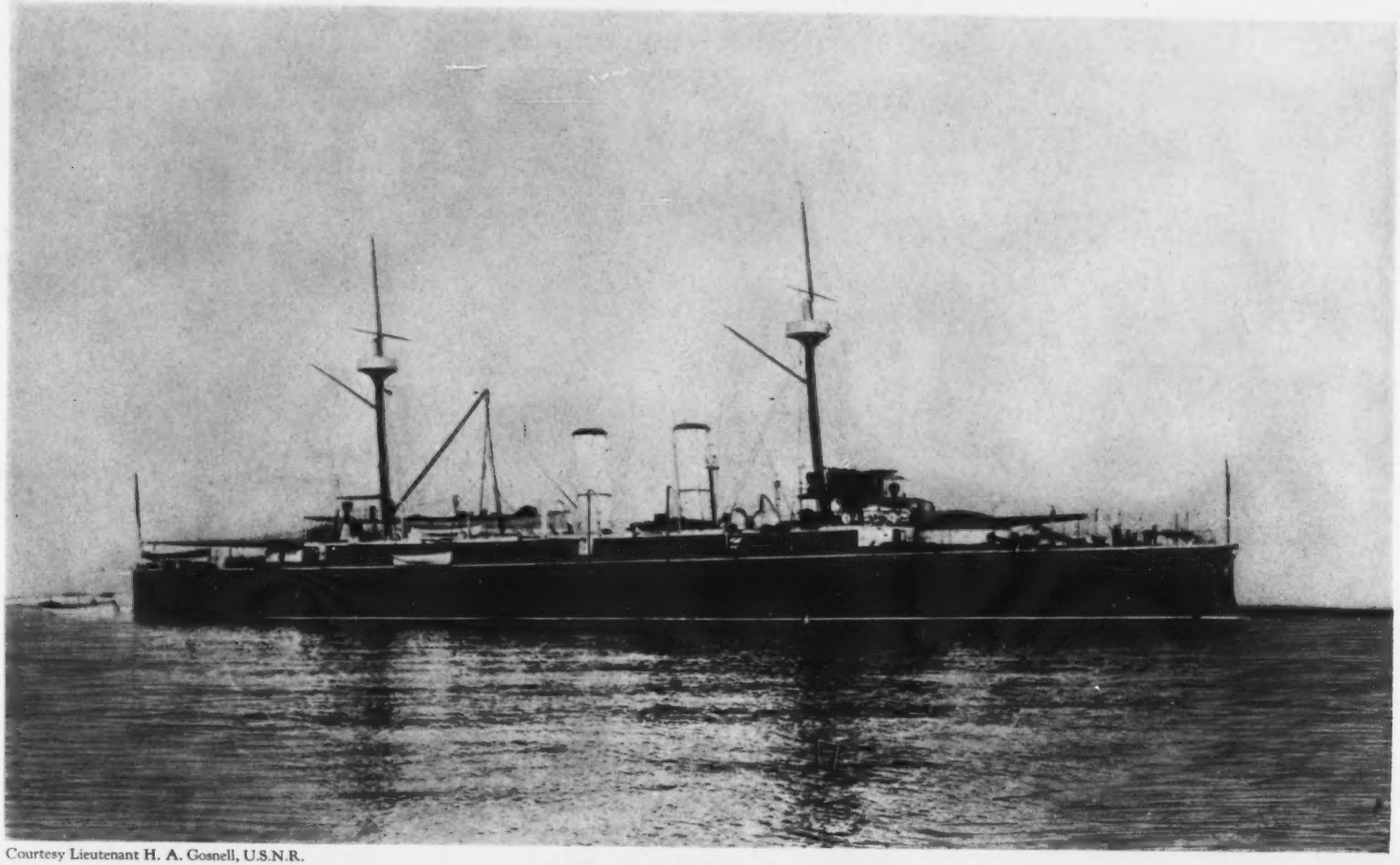


Courtesy Lieutenant H. A. Gosnell, U.S.N.R.

ARMORED CRUISER *VISCAYA*

Sister ship of the *Maria Teresa*. Her last docking was just a year prior to her destruction. With all guns out of action, she attempted to ram the U.S.S. *Brooklyn* before heading for the beach.



Courtesy Lieutenant H. A. Gosnell, U.S.N.R.

ARMORED CRUISER *ALMIRANTE OQUENDO*
Sister ship of the *Maria Teresa* and the *Viscaya*.

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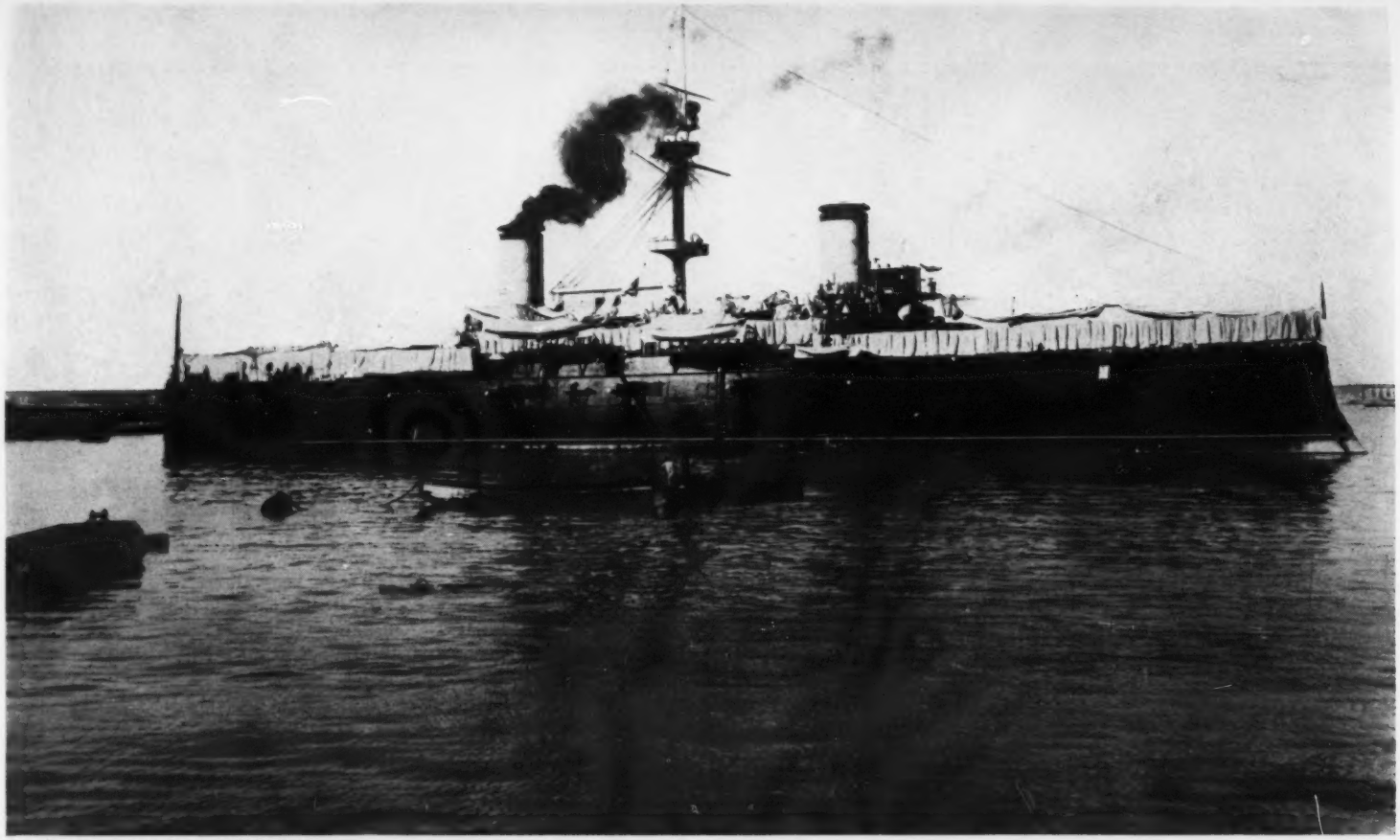
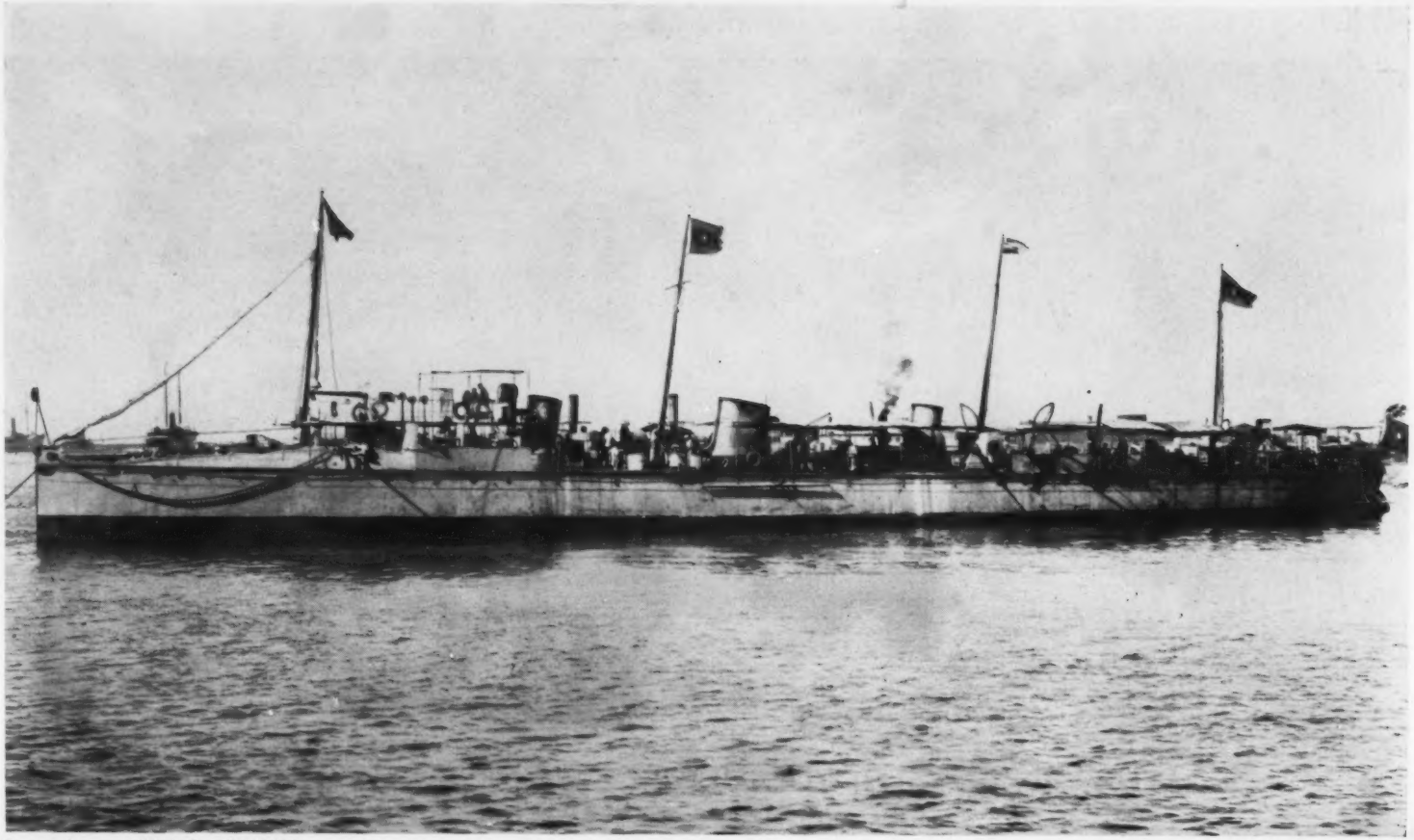


Courtesy Lieutenant H. A. Gosnell, U.S.N.R.

ARMORED CRUISER *CRISTOBAL COLON*

Purchased from Italy just prior to the outbreak of war. Speed 20.5 knots, 7,000 tons, two 10-inch guns (never received), ten 6-inch guns, six 4.7-inch, ten 2.2-inch, ten 1.4-inch, two machine guns and four torpedo tubes.



Courtesy Lieutenant H. A. Gosnell, U.S.N.R.

DESTROYER *FUROR*

380 tons, flagship of Captain Villaamil, commanding the torpedo flotilla of Admiral Cervera. This was the only ship actually sunk in the engagement. Captain Villaamil was among those lost.

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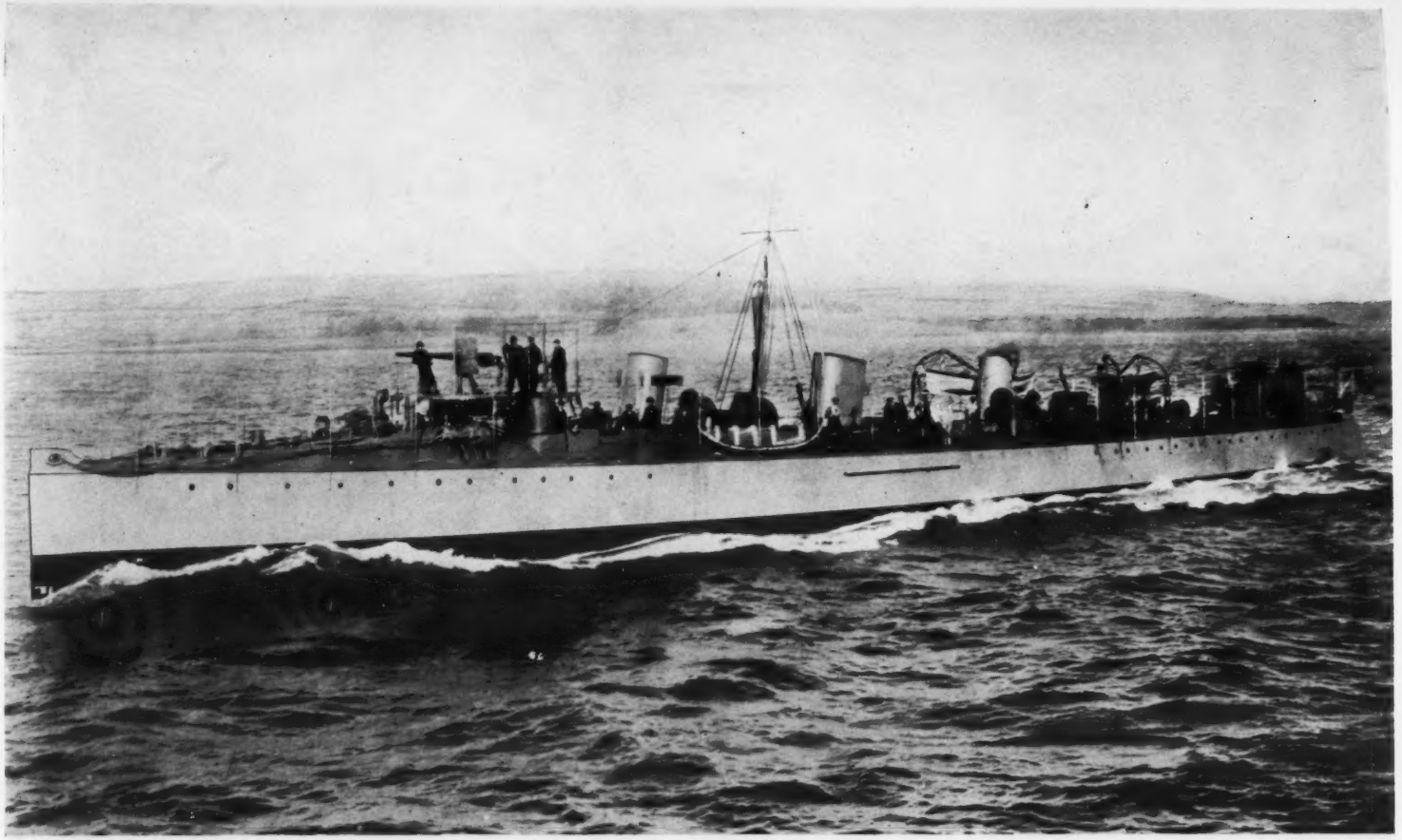
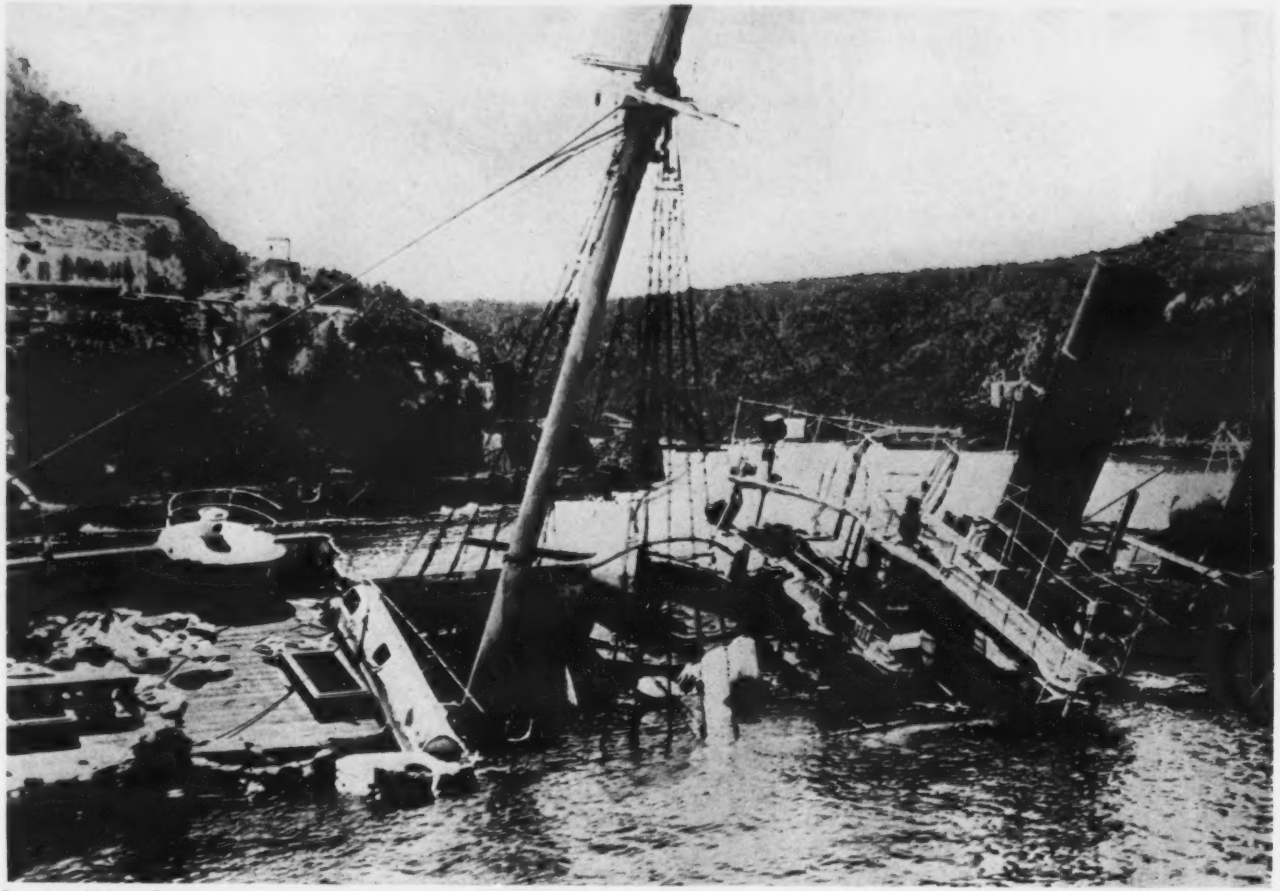


Courtesy Lieutenant H. A. Gosnell, U.S.N.R.

TORPEDO-BOAT DESTROYER *PLUTON*

Being the last ship out of the harbor, she was quickly driven ashore. The three Spanish destroyers each mounted two 12-pounders and two 6-pounders but had received no effective torpedoes.



International Newsreel

THE *REINA MERCEDES*, SUNK IN ENTRANCE TO SANTIAGO

The Spaniards, on July 6, 1898, three days after the battle, sought to block the entrance to the harbor by sinking the *Reina Mercedes* in the channel. She was later salvaged by the United States and is now station ship at the U.S. Naval Academy, Annapolis, Maryland.

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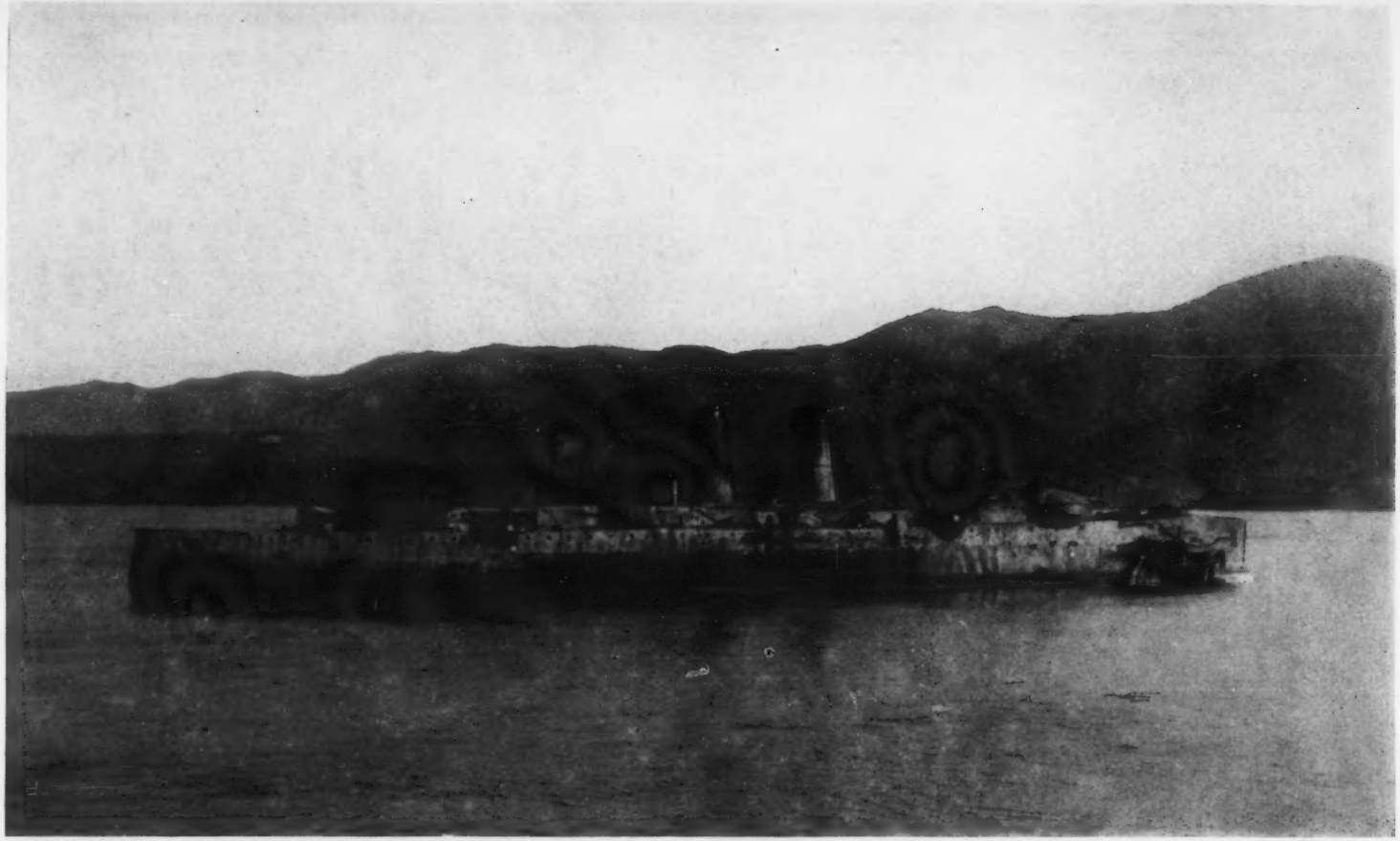


International Newsreel

WRECK OF THE *VISCAYA*

Picture was taken while the ship was still burning.

THE LAST OF THE *CRISTOBAL COLON*
Driven ashore after a running fight to the westward from Santiago.

International Newsreel

The Squadron *of* Admiral Cervera

An Account of the Insurmountable Handicaps Imposed Upon a Noble Body of Men

By LIEUTENANT HARPUR ALLEN GOSNELL, *U.S.N.R.*

AS THE thirtieth anniversary of the Battle of Santiago passes by, few will fail to recall the decisive manner in which Admiral Sampson's ships annihilated the Spanish fleet. How many, though, have ever heard the Spanish side of the events leading up to the battle? Many no doubt remember that their ships were inferior in power and that their crews had not been efficiently trained. That is but a small part of the story, however. If we scan the various statements, articles, and documents from contemporary Spanish sources we find countless interesting points and a few amazing disclosures. These pages, then, will undertake to recount some of the lesser known facts and incidents preceding and bearing upon the battle, rather than to describe or discuss any phases of the battle itself.

SPANISH NAVY DECADENT

Of course the fundamental source of all of Cervera's troubles was the hopeless and helpless state of the entire Spanish Navy and its organization at that time. The state of decay extended back for decades. In spite of the fact that war had threatened imminently for months, Cervera's ships were very nearly the only ones capable of even going to sea when the war finally did break. No money was available for urgent repairs to ships; many months' back pay was due the personnel. Cervera was not even able to obtain charts of Western Atlantic waters nor information as to the defenses of various Spanish harbors in this hemisphere.

Strange to say, in the face of the complete deficiency of the Spanish Navy, it was most grossly overestimated both in Spain and in the United States. Cervera well knew his navy's many and sad shortcomings. He devoted his best energies to the end that his superiors might adso realize the true state of affairs. His was a voice crying in the wilderness, however. The minister of marine at one time even outlined to him a plan whereby the Spanish Navy would destroy Key West and then cut off other Atlantic ports, although in the meanwhile it might be necessary to engage the American fleet in order to maintain control of the sea. At a last banquet to Spanish naval officers, a serious affair where duty was the keynote, the archbishop himself proposed a toast to their assault upon the city of Washington! And who will forget the panic that seized many Americans dwelling in the coast cities after Cervera left the Cape Verdes—the demands upon the government to apportion ships *to each city* for protection against the terrible enemy fleet. This hysteria was undoubtedly part reason for the theoretically unwise division of the American Atlantic fleet—the formation of the "Flying Squadron."

Early in April, 1898, events began to move at a more rapid pace. Cervera had been pleading that the plan of campaign for the approaching war be outlined to him. The minister of marine, less than three weeks before the outbreak, replied with this extraordinary despatch:

> Your cipher telegram received. In these moments of international crisis no definite plans can be formulated.

Possible explanations of such sentiments are that the minister either was unable to conceive a plan or else he had already decided upon the procedure later adopted and did not desire to apprise Cervera thereof any sooner than necessary. This latter view is strengthened by the unique means by which the orders were finally delivered. Cer-

THE LAST OF THE *CRISTOBAL COLON*
Driven ashore after a running fight to the westward from Santiago.

vera left Spain for the Cape Verdes where his squadron was assembling. His orders were dispatched on an eight-knot collier which left Cadiz almost immediately after him and was to stop en route at the Canaries for coal!

The Squadron of Admiral Cervera

As is well known, the fatal orders directed Cervera to sail for the West Indies. At this point it is fitting to describe the units which he was finally able to take with him. The squadron consisted of the four armored cruisers *Infanta Maria Teresa* (flag), *Viscaya, Almirante Oquendo,* and *Cristobal Colon,* and the three torpedo-boat destroyers *Pluton, Furor,* and *Terror.* The first three of the cruisers named above were Spanish-built sister ships of 7,000 tons, mounting two 11-inch, ten 5-inch, eight 2.2-inch, eight 1.4-inch, two machine guns and six torpedo tubes. Their armor belts were twelve inches, turrets ten and one-half inches and protective deck three inches in thickness. Each one of them was credited with a trial speed of over twenty knots. The *Colon* was purchased in Italy at the last minute and was of practically the same size and speed as the other three. Her armament consisted *theoretically* of two 10-inch, ten 6-inch, six 4.7-inch, ten 2.2-inch, ten 1.4-inch, two machine guns and four torpedo tubes. Almost her whole side as well as her turrets were covered with six-inch armor and the protective deck was one and one-half inches in thickness.

The three destroyers were almost brand new. The *Furor* and *Terror* displaced 380 tons and made twenty-eight knots on their trials. The *Pluton* weighed 420 tons and was once capable of thirty knots. All three were armed with two 12-pounders, two 6-pounders, two 1-pounders and two torpedo tubes. These seven ships were not insignificant *on paper* but, as will be seen later, their actual strength was but a shadow of their paper strength. In any case they could have competed on even terms with no more than a small fraction of the American Atlantic fleet, not to mention the *Oregon.*

Cervera's Strange Orders

Cervera's orders were, specifically, to steam to Porto Rico and there coöperate in the defense of that island. The orders were later modified to grant greater latitude of movement and choice of destination in the West Indies. Any such plan of course meant absolutely certain and complete destruction or capture. The content of the orders was not a complete surprise. The Admiral had long feared such a fatal decision. Nor had he hesitated to voice his objections, always backed by sound reasons. The Spanish penal code forbade any praise of the enemy but Cervera time and again risked censure and punishment since he clearly saw it to be his patriotic duty to make known to those over him the true situation. The last and strongest protest followed the receipt of the orders. A council of war of the several captains was held aboard the flagship and the proceedings cabled back to the minister of marine. This rather brief dispatch confirmed and emphasized Cervera's many protests and urged reconsideration of other plans of campaign.

Almost immediately, and long before the full report of the meeting could reach Spain, the minister called a meeting of the eighteen general officers of the navy to act upon the dispatch received. The surprising result was that fourteen voted that the original plan be adhered to. The opinions of the other four differed only in that they were in favor of a delay for reënforcements. In the meanwhile Captain Villaamil, commanding the torpedo flotilla, had addressed a cablegram to the premier giving his unqualified opinion that their utter destruction was assured by the proposed step. He was a deputy and was thus able with safety to make his sentiments known. The minister of colonies replied to his protest with a brief message in English which read simply: "God bless you"! This same unusual individual, on an earlier occasion, had given his opinion that the war "would not be of any importance anyway because as soon as the Americans had sunk three or four Spanish ships peace would be concluded." Was he far wrong?

The reasons which led to Cervera's being ordered to the West Indies have always been a puzzle. They will, in all probability, never be known definitely. This paper cannot undertake to analyze all the evidence and discuss the various possibilities. It seems to the writer, however, that those who had the decision to make, felt that it would look better were they to *do something,* however certain to be fatal, rather

than to follow the proper course and appear to *do nothing* by waging a defensive naval war. And so they sent out Cervera with the only available ships—the one thing they could think of. Admiral Montojo, the gallant Spaniard who at Manila suffered the penalties of his government's shortcomings, gives perfect expression to the situation:

"Alas for the vanquished!" is an old saying, but we should now add: "Alas for those who are sent out to be vanquished!"

Every Ship Unready

The die had been cast. The ships must go. Scarcely prepared for the 3,000-mile run, let alone all the eventualities of an overseas campaign, they set forth woefully deficient in things large and small. Cervera had been unable to get the simplest navy yard jobs done or to secure in adequate quantity the most necessary supplies of any sort. He graphically described his plight in three short words: "We have nothing." The *Terror's* boilers were in wretched shape. The *Viscaya's* last docking had been just a year prior to the coming Battle of Santiago. Her bottom was so foul that the Admiral described her as "nothing more than a buoy." The limit of accomplishment at Cape Verdes of the fleet divers was to clean her propellers and sea cocks. She had just ended a long round trip to the United States, the *Oquendo,* in addition, coming from Havana at the same time.

Although the vast ordnance deficiencies will be outlined later it will be mentioned at this point that the *Colon* had never received her two heavy guns. The usual interminable delays had prevented and the government had not seen fit to take Cervera's advice and accept two inferior guns rather than risk having none at all. Once more Cervera was right. The dispatching of the *Colon* before receiving her principal offensive weapons never fails to bring to the writer's mind the tale of the Irishman, the hunter who was observed aiming his gun at a bird. When told that the gun was not loaded and that, therefore, there was little use of pulling the trigger he replied that he could not delay as the bird would fly away before he would have time to load.

After endless delay in coaling, the squadron finally got under way on April 29. The run to the West Indies was marked by little more than the natural difficulties encountered in towing the destroyers which were not fitted with proper bridles for such service. Two days before sighting land the torpedo craft were cast off to steam under their own power. The *Furor* and *Terror* were sent ahead to obtain information at Martinique and the *Terror* immediately broke down. The *Furor* went on alone and learned of little but the annihilation of the Spanish Asiatic fleet at Manila. After the return of the *Furor,* Cervera drew near to Martinique in order to leave the *Terror* to repair her boilers in the neutral harbor of Fort de France. She later escaped from there, avoiding both internment and destruction, and made her way to San Juan, Porto Rico. From this point on, therefore, she was no longer a member of Cervera's squadron.

Cervera's Ill Fortune Reaches Its Climax

At this juncture two frightful pieces of bad luck were encountered by Cervera. To begin with, there was to be a vitally needed collier at Curaçao for him. When he cabled home his "arrival" at Martinique the minister of marine changed the collier's destination to Martinique, cabling the change to the Admiral at that station. He never received the message since the *Furor* and *Terror* were the only ships of his squadron that had made port there at all. Moreover, by the time the dispatch arrived the squadron was on its way to Curaçao.

As if this were not enough, the crowning climax was his failure to receive another cablegram sent to him at Martinique on the same date. It read:

Situation changed since your departure. Your instructions amplified so that if you do not believe that your squadron can operate there successfully, may return to Peninsula, choosing route and destination, preferably Cadiz. Acknowledge receipt and indicate decision.

Here at last was the consummation of Cervera's efforts extending over many months. Those higher up at last saw the light. With coal from his collier he would soon have been on his way back to Spain instead of being headed for the certain destruction of his ships and the death of hundreds of his men. But, tragedy of tragedies, he missed the dispatch. The viewpoint of the general officers at home had probably been changed, first, by the receipt by mail

of the full report of Cervera's council of war at the Cape Verdes; further, by the Manila disaster, and perhaps also by the naval bombardment of San Juan.

From then on matters went from bad to worse. Upon arrival off Curaçao, not only was the collier unaccountably missing, but the Dutch enforced their neutrality laws strictly, allowing only two ships to enter the harbor and allowing these to ship only 400 tons of coal. The collier, next ordered from Martinique to Curaçao, arrived too late there also and, after starting on to Santiago, was captured en route. If Santiago had not already been decided upon by Cervera and his officers as the most suitable destination, the pressing shortage of coal would have forced the decision at this time. From Curaçao to Santiago the voyage was uneventful. As an example of the complete lack of information which Cervera had to put up with in his operations, it might be of interest to note that for several days the *Oregon* was in reasonably close proximity although he believed her still to be in the Pacific.

Cuba Already Lost

The reception, or lack of it, which the squadron met with upon reaching Santiago is significant. Few even came down to the water front to witness the arrival of the ships. Except in the hearts of a few Spaniards there was little interest or even curiosity inspired. Cervera had written on February 26:

> . . . . To defend an island which was ours, but belongs to us no more, because even if we should not lose it by right in the war we have lost it in fact, and with it all our wealth and an enormous number of young men, victims of the climate and bullets, in defence of what is now no more than a romantic ideal . . . .

His words could scarcely receive more conclusive confirmation than by the sentiments of the Cubans made so evident that day; "we have lost it in fact," was only too true even before the struggle.

Santiago an Unfortunate Choice

When Santiago was selected as the destination of his squadron Cervera could not well have picked a base more poorly fitted for his purposes. He was not to blame; he had not been furnished with information as to the equipment of any of the West Indian ports. It was fate. By taking all the coal on hand there was nearly enough to fill the bunkers of his ships. Fresh water, however, was most exorbitant in price and almost unobtainable in quantity for his boilers and his reserve feed bottoms; and worst of all, there were absolutely no facilities for taking aboard either coal or water. The lack of tugs, lighters, water boats, handling devices, etc., was almost complete. Only one example will be given: it was not possible to purchase in the entire city anything like enough *baskets*, even, to use in coaling. When the ships left on their final dash they had not in six weeks succeeded in filling their bunkers! Although they were not blockaded for ten days after their arrival they were unable to leave before then for lack of coal. Of course, it would have been of little avail to have gone elsewhere anyway. In fact the fate of the ships was sealed from the day the Admiral missed the cablegram authorizing his return to Spain. One strange feature of the ten days immediately preceding the establishment of the rigid blockade is that the Spaniards never seemed to realize that, until that time, the Americans had not assured themselves definitely of the presence of the Spanish squadron.

Ordnance Shortcomings Unbelievable

The list of the ordnance faults of the ships sounds like a nightmare, as indeed it had been for Cervera for months. His best efforts had been unsuccessful in correcting any of the troubles. It has already been stated that the *Colon* was without her big guns. The other three cruisers had fired a total of exactly two rounds per gun in target practice with their heavy guns. This was not enough even to show up defects and when the day of battle arrived, it was found impossible to close the breech of the *Teresa's* stern gun after the first shot. Not one single effective torpedo had reached the squadron. The field guns of the *Viscaya* and *Oquendo* were unserviceable and the *Teresa* had none at all—an important item when we consider that two-thirds of the crews of the squadron aided in the defense of the city by land.

The situation in connection with the heavy broadside guns was even more appalling. Two of the 5.5-inch guns on the *Viscaya* were useless, and one on the *Oquendo*. The condition of the 5.5-inch ammunition was

almost unbelievable. About eighty-five per cent of it was known to be defective before the battle—fuses and primers unreliable and cartridge cases of incorrect size. Considering faulty breech design also, it was realized that the expanding gases of the propelling charge would be likely to backfire through the breech—perhaps even blow off the block—endangering the lives of the gun crews. These casualties indeed occurred during the battle. There was therefore the dilemma of foregoing target practice entirely or risking the lives and morale of the crews. The former procedure was adopted with the result that the Spanish fleet went into action without having fired one single practice shot from these guns!

Two years of dickering with the makers had brought just 300 new cartridge cases for all the 5.5-inch guns on the three Spanish-built cruisers. The defective ones had to be used anyway. When the time came it happened more than once that seven or eight of these old cases had to be tried before one could be found which would fit. Other difficulties encountered by the broadside gun crews included the blowing out of firing pins, the impossibility of closing the breech after two or three shots, breakdowns of the ammunition hoists, etc. The decision to omit target practice was undoubtedly wise.

As for the *Colon,* besides never having gotten her big guns, she had never received her apparatus for reforming and recharging either her 4.7-inch or her 6-inch cartridge cases. Thus the seventy-two extra powder charges per gun which she had aboard were absolutely useless.

Although a description of the harbor defense batteries does not properly belong in this narrative, it will nevertheless be mentioned in passing that there were exactly two modern guns on the heights at the entrance to the channel and there were only 200 rounds of ammunition for both of them. One of the venerable defenders bore the original date of 1668, whereas five, dated 1724, *had just been mounted.*

The Ultimate in Lack of Perception

Perhaps the most astounding document of the entire war was the message of June 3 from the minister of war to the governor general of Cuba. It should be borne in mind that by that date Cervera had been bottled up tightly by a tremendously superior American fleet. The dispatch is given in full without comment:

> Very serious situation in Philippines compels us to send there ships and reënforcements of troops as early as possible. To be able to cope with hostile squadron at Manila it will be indispensable to send an equally strong fleet there. At present only two warships here and one of them I believe cannot pass through canal. The only thing we can do is to send all the ships of Cervera's squadron that can get out of Santiago. But before deciding, the Government wishes to know your opinion as to effect the withdrawal of Cervera's fleet might produce in Cuba. This movement would be only temporary, and as soon as object is attained in Philippines the squadron would return to Cuba without loss of time and strongly reënforced.

Forty to One

The fall of Santiago was approaching, the occasion which would force Cervera to make his dash or destroy the ships inside the harbor before they should fall into enemy hands. He was now under the orders of the governor general, a happy circumstance for him, as he was not willing on his own initiative to order hundreds of his officers and men to go out to certain death. A contemporary expert estimated the disparity in fighting strength of the opposing fleets at forty to one. This seems not impossible if we consider the deficiencies under which the Spanish ships labored. One of the Spanish captains estimated that under the protective decks of the American ships "there was no other danger to the life of a man than that of dying of old age."

On the day of battle the high spirit of every officer and man reached its zenith. From the very beginning of the crisis, months before, the morale of the crews could bring forth nothing but praise—and this despite the fact that they operated continually without proper facilities, supplies, equipment, ammunition—even pay. When the sacrifice was ordered, however, there was still nothing but eagerness for battle. How different from the crews of Scheer, who mutinied rather than offer a final unequal battle even though a victory and the winning of the war were still at least possible. No victory was possible for the Spaniards.

The Gallant Vanquished

History should never fail to record the nobility exhibited by the Spanish ships dur-

ing their necessarily slow passage through the narrow, tortuous channel out to sea. This was done under the heaviest fire, especially in the case of the later ships to emerge. No reply could be made to the Americans' fire. Only the bow gun of each ship would bear. And the fire of the bow gun of even the leading vessel had to be withheld in order that the piloting past the dangerous rocks be not interfered with. Every Spanish ship had to undergo this ordeal for many minutes and not one faltered. Finally for each the turn to the west could be made, the pilot was dropped and "commence firing" sounded; speed was increased and the race was on.

We will not deal with the battle here. Suffice it to say that it was waged by the Spaniards with the same gallantry as that by which all their earlier operations were marked. The *Viscaya*, with all guns out of action, made a totally infeasible attempt to ram before turning ashore. It may be said of all the ships individually and collectively that they attempted the impossible and failed.

We have heard now of Cervera's trials and tribulations; we know the workings of uninformed public opinion. Realizing the bitter irony of fate, would it be unreasonable for one to guess that Cervera was held to blame for the destruction of his squadron? This was actually the case! For months he was the scapegoat but was fortunately cleared of all censure at last by the full exposition of the facts.

One of the saddest incidents connected with the engagement was the first report from the commandant-general of the navy, Santiago, which was repeated to the minister of marine in Madrid. It stated:

> Our squadron went out, keeping up galling fire, which could hardly be heard for hostile fire. Has apparently succeeded in running blockade, taking westerly course.

Even two days later it was reported that the *Viscaya* and *Colon* had escaped.

One strange feature of the operations was the coincidence that Captain Concas of the *Teresa* had, a few years previously, on a replica of Columbus' *Santa Maria*, taken part in a pageant depicting the beginnings of Spain's dominion in the Western Hemisphere. Now he was an only too prominent actor in the final passing of her glory from the New World.

An Engineering Hypothesis

It is very dangerous even to hazard a guess as to the possibility of Cervera's escape under any circumstances. Assumptions must be made which may be entirely false. Therefore any thesis propounded long after a battle is likely to err in some serious respect. Nevertheless the following idea is brought forward if only as an interesting conjecture.

Cervera's chances lay in the potential speed of his ships. All had exceeded twenty knots on their trials and all had been in commission but a few years. As soon as it was fairly certain that a long stay in Santiago was in order, and that it would be concluded by the final contest, the utmost endeavors should have been made to put the boilers and engines in as close to perfect condition as could possibly be managed. Here enters the dangerous assumption that their condition at that time, the availability of spare parts and shop facilities, as well as the skill of the engineer ratings, would have permitted the work to be consummated. If it was humanly possible, however, every single boiler should have been emptied, cleaned and overhauled and every main engine put in perfect condition.

The hull of every ship should have been scraped by divers even if it were a job of weeks' duration and performed by inexperienced men. If necessary, elementary diving helmets could have been constructed, so designed as to rest upon the shoulders, and each supplied with air by any simple hand pump and hose. If all the above undertakings were successfully accomplished it might have been possible to get the ships in condition for a run at, say, eighteen knots at least. This is better than anything of which the American battleships were capable, even after working up to full speed. The next requirement was *full power* immediately after clearing the channel. This means not only all boilers lit off and on the line at full pressure, as was actually the case doubtless, but also all boilers actually *delivering* full power under forced draft by that time. Since the channel had to be negotiated at low speed this means that a vast quantity of high pressure steam would have to be bled direct to the main condensers. Even if necessary to release it through the safety valves the loss of feed water

would be justified. This was the one hour in the lives of the ships that counted and all should have been subordinated to the one end.

If, then, full power were available and a high speed thus attainable almost immediately after the turn to the west, escape would have been pretty nearly assured *considering the circumstances* under which the American fleet was caught. Not only was every American ship equipped with Scotch boilers, but also only two of them even had all their boilers lit off; some of the main boilers were even empty! In fact the *Colon,* with her Niclausse boilers, was the only quick steamer in the battle. Due to the exigencies of the blockade the American ships were not so clean, either as to hull or boilers, as might otherwise have been the case. On the morning of the dash the *Massachusetts* was absent and the *New York* out of reach, at first anyway. And a big gap had been allowed to remain in the western end of the semicircle of American heavy ships.

The destroyers' chances for safety would lie in the possibility of their gaining the disengaged side of their cruisers before being disabled. As for the cruisers it would seem that the fire hazard was their chief danger, for the American shooting was really quite poor that day. All the wood that could possibly have been dispensed with should have been ruthlessly ripped out before weighing anchor. Fire fighting and the conservation of all steam possible for the main engines should have been the primary considerations, outweighing any offensive action. When we consider the fact that the *Colon* actually did outdistance the American ships until her good coal was consumed, it is not unreasonable to assume that all of the cruisers, at least, could have gotten clear away.

There are several assumptions and a great deal of hindsight contained in the above discussion and it is properly contended that foresight is less effective. The arguments, therefore, may not have a great deal of weight. In any case, the escape of Cervera's squadron, say to Havana at best, would have gained no more than a postponement of the evil hour. The method of escape is an interesting possibility nevertheless, over which to ponder.

The Sailors of Spain

It may safely be said that Cervera did all that one man could possibly do toward the effective advancement of the Spanish cause. That he assumed the gigantic handicaps which were forced upon him and still carried on courageously, accomplishing as much as he did, is all the more to the credit of him and all his subordinates, officers and men. The entire story of those months could hardly be summarized more effectively than by a contemporary statement:

> If Spain were as well served by her statesmen and public officials as she is by her sailors she might yet be a great country.

The Gloucester at Santiago

By COMMANDER L. J. GULLIVER, *U. S. Navy*

"After the torpedo boat—what?"—English newspaper, July 4, 1898.
"The *Gloucester* of course."—New York newspaper, July 5, 1898.

THIS summer will mark the thirtieth anniversary of the most smashing fight and extraordinary victory that has ever been won by a vessel of our Navy—the total destruction in a fair sea battle of two enemy torpedo-boat destroyers by an American armed yacht, the U.S.S. *Gloucester*. The deeds of the *Gloucester* on that Sunday afternoon, July 3, 1898, stand out truly gloriously; and fine as was the achievement of the American fleet in its annihilation of the squadron of Cervera off Santiago, the spectacle of the *Gloucester* in this battle thrilled her squadron mates so that they wildly cheered the dashing, reckless, slashing yacht.

A new generation of naval men has come to help man the ships of the Navy, since the *Gloucester's* day and deeds, and it is these officers and men who come to mind when her war record is recalled. With the hope that recital of her fight may be of some inspiration and interest to them, the story is set down here.

When Congress declared, in April, 1898, that a state of war existed between Spain and the United States, the *Gloucester* was a pleasure yacht. She had been well built and especially well engined, but her designers in laying down her plans naturally had no thought that she would ever be called on to fight against large protected cruisers and "deep" sea torpedo-boats which, at this time, were thought to be, and probably were, the latest and best products of English builders of war craft. Incidentally, there arose after the Battle of Santiago considerable doubt as to the fighting qualities of the Spanish ships, but naval intelligence of that day had it that Spain's ships were good and such they were in the minds of the officers and crew of the *Gloucester*. It is easy enough now in the light of what we know of the lack of fighting qualities of the Spanish ships to evaluate the American victory accordingly, but everyone should keep in mind that in 1898 the naval world regarded Spain's ships as formidable. With the declaration of war, the *Gloucester* was "taken over."

Until then, she had been the *Corsair*, flying the colors of the New York Yacht Club. At a private shipyard magazines were bulkheaded off, and a very respectable battery was placed on board—a forecastle 3-pounder, four waist 6-pounders, and three 3-pounders abaft the deck house. There were also two Colt automatic rifles with "movable mounts." None of these guns had any shields or other protection for the crew. The *Gloucester* had no fire control gear—the captain's voice shouting from the bridge could be heard from bow to stern. There were no spotters, no telescopic sights, no splinter bulkheads—just eight guns and a good supply of ammunition. The conversion of the yacht *Corsair* to the gunboat *Gloucester* was a quick job and cost the United States but very little money.

The *Gloucester* was of the fourth rate according to the front page of her log, and her first and only captain was Lieutenant Commander Richard Wainwright, U. S. Navy. Lieutenant Harry McL. P. Huse was executive officer and navigator. Both of these officers later became rear admirals in the Navy. Past Assistant Engineer G. W. McElroy was chief engineer. The other officers, except Naval Cadet Andre M. Proctor, were volunteers, and conducted themselves right nobly throughout the *Gloucester's* stirring career; later, we shall hear more of these fighting volunteers.

Lieutenant Commander Richard Wainwright brought to his first command a Navy record of high achievement and, incident-

ally, he was the only captain at Santiago who had a personal account to settle with the Spaniards. He had only a few months before, as executive officer of the *Maine*, seen his shipmates burned, mangled, and drowned in the black waters of Havana harbor. Captain Wainwright had reason to "Remember the Maine."

Richard Wainwright came from fighting Marine Corps and Navy stock. His grandfather was a lieutenant colonel of marines and his father was Farragut's flag captain in the *Hartford* at New Orleans and Vicksburg.

The *Gloucester's* crew, numbering fewer than ninety men, came over the side and turned to just as they were, without training of any kind. They were in the main volunteers, this being the descriptive term in those days for those who "signed up" under the ardor of war. Among the ratings were some we never hear of nowadays —landsmen, coal passers, ordinary seamen, oilers, shipwrights, and baymen. The proportion of rated men to non-rated was very small, but Captain Wainwright promptly corrected this by jumping several men from seaman to chief petty officer. Seaman John Bond went to chief boatswain's mate and became a tower of strength to his captain in the hour of battle; Seaman Bechthold jumped to chief quartermaster, and Seaman Patrick Meehan was promoted to chief master-at-arms, and like the capable sailorman that he was, his answer was, "Aye, aye, sir," when called on by Lieutenant Huse to read the Catholic burial services, when a captured Spanish sailor who had died of wounds received in the battle, was lowered over the *Gloucester's* side. One of the *Gloucester's* signal quartermasters, who in the smoke of early firing, "rightly" guessed the historic signal,* "Gunboats will advance," flying from the *Indiana* as the Spanish fleet emerged from Santiago harbor, was George (Charlie) Noble, six weeks before the battle a newspaper reporter in San Francisco.

Among the plans for converting the *Gloucester* to a regular gunboat was placing a fairly heavy layer of armor on her sides—good protection, no doubt, that would probably have rated her third class instead of fourth; but this project, so strongly urged, was successfully resisted by Captain Wainwright, and on his decision really rested the *Gloucester's* fame in the fight that was to come. He chose to take her as she was—unprotected—but with her speed undiminished by the weight of the proposed armor. Had Captain Wainwright acted differently, the *Gloucester* would never have had the speed to overhaul the fleeing Spaniards. She would have been protected, but the mantle of glory would never have touched her. As it turned out she needed no protection, but she assuredly did need her speed and she had it in full measure.

It may be well to say right here that Captain Wainwright's decision to ignore the question of protection and to think only of how much speed he could make if the chance to attack should be his lot, summed up in a few words his strategy and tactics: "Let's get at them quickly." No one on board the *Gloucester* before or during the fight had any idea of being hit, and when the time of battle came each man "made it so."

Filling her bunkers with ninety-three tons of bituminous steaming coal, the *Gloucester* put to sea on May 29, 1898, and six days later she had reported to Rear Admiral Sampson, commander-in-chief of the naval forces in Cuban waters. From this time on, the *Gloucester* was a busy gunboat, what with being fleet messenger boy, carrying dispatches, and standing blockade duty with the four battleships and the *Brooklyn*, much like a ratey midshipman given a regular deck watch with a lot of "bull" lieutenants.

When the great moment of the war came, the *Gloucester* was on watch and not on a mail and dispatch trip. Lucky *Gloucester!* Yes, and deserving *Gloucester!*

Although the blockade of the Spanish ships in Santiago harbor by Admiral Sampson's fleet had been in effect only a little more than a month, the officers and crews of our ships had begun to tire of the inaction. There had been plenty of excitement when the bottling-up process started near the end of May, and there were at first numerous volunteer lookouts aloft day and night. Expectancy was high that the Spanish fleet would come out and fight. No one wanted to risk being below and asleep

*The signal actually hoisted by the *Indiana* was, "Enemy ships are coming out." Charlie Noble's mistake was to the *Gloucester's* advantage since as read by him it meant that the *Indiana* saw and approved the *Gloucester's* dash at the enemy and would direct her own guns so as not to endanger the *Gloucester*.

when the Spaniards made the dash. But as the days wore on and Santiago harbor continued as quiet as the grave, the blockade became dull work. Lookouts had to be jacked up. The Navy's itch for a fight seemed less likely each day ever to be satisfied.

And so Sunday morning, July 3, 1898, dawned—a beautiful day, a tropical sun, and a calm, rolling sea. The *Gloucester* was under way as usual with steam on all boilers, full steaming watch below, and ammunition by the guns. She was on her station holding the easterly flank of the blockade line and lying about two miles south and east of the Morro, guarding the entrance to Santiago harbor. At 9:00 A.M. the word had been passed, "All hands to quarters; uniform white mustering; stand by for general muster." Half an hour later while Captain Wainwright and the executive were in the act of inspecting the lower decks, they heard the well known pounding of sailormen's feet tearing along the spar deck, followed by the barking of guns. That was the end of that Sunday inspection. When Captain Wainwright reached the bridge he saw the Spanish fleet standing out of the harbor, battle-flags streaming out astern, and bursts of flame coming from its guns. The *Gloucester* was cleared for action and the order to commence firing was instantly given. The flagship, *Infanta Maria Teresa,* with Admiral Pascual Cervera on board, led, followed by the *Oquendo, Viscaya,* and *Colon.* Strangest of all strange tales, the leading Spanish ships stopped when clear of Diamond shoal, just outside the harbor, to drop their civilian pilots! Two thousand yards astern of the *Colon* came the English-built destroyers *Pluton* and *Furor* under Flotilla Commander Captain Villaamil, Royal Spanish Navy.

Before the Spanish destroyers appeared in sight, the *Gloucester* opened fire with her 3-pounders and 6-pounders on the Spanish flagship and headed in towards the enemy column, but very soon Captain Wainwright decided that his particular business that day was the Spanish destroyers, and slowing his engines, he directed that a full head of steam be "bottled up" preparatory for the running dash that he meant to make at them, following the good old Navy primitive tactics, "Let's get at them quick." Immediately the *Pluton* and *Furor* showed themselves at the harbor mouth, Captain Wainwright rang full speed ahead, and porting his helm, he drove down upon them, his forward guns concentrating on the leading *Pluton* and the after 3-pounders on the *Furor.* The *Gloucester* was "traveling"—a good seventeen knots—a lot of speed in '98. She was making a brave sight, too, with a bone in her teeth, and a constant sheet of flame, white-red in the Cuban sun, bursting from her spar deck guns. For a while, but for such a short while, the Spanish gunners on the *Pluton* and *Furor* returned the fire. The fire from their machine guns, while of good volume, constantly fell short. These weapons, properly handled, were capable of wiping out the *Gloucester's* gun crews who were without the least protection. The Spaniards never were able to get the rapidly decreasing gun range before they were swept off their decks by the really accurate and overwhelming fire of the *Gloucester's* gun crews. The Spaniards simply never could get started. In a very few minutes the *Pluton* was seen to be on fire, and with hard a-port helm, she was headed for the beach, where she grounded and promptly blew up. The *Gloucester's* gun crews now concentrated on the *Furor* and she too was seen to be in flames and with her steering gear completely smashed, she turned helplessly to port toward the *Gloucester* and surrendered through the medium of a white shirt waved by one of her crew.

This is what Admiral Sampson, the commander-in-chief, said in his report:

> The skillful handling and gallant fighting of the *Gloucester* excited the admiration of every one who witnessed it, and merits the commendation of the Navy Department. She is a fast and entirely unprotected auxiliary vessel—the yacht *Corsair*—and has a good battery of light rapid-fire guns. She was lying about two miles from the harbor entrance, to the southward and eastward, and immediately steamed in, opening fire upon the large ships. Anticipating the appearance of the *Pluton* and *Furor,* the *Gloucester* was slowed, thereby gaining more rapidly a high pressure of steam, and when the destroyers came out she steamed for them at full speed, and was able to close to short range, where her fire was accurate, deadly, and of great volume.
>
> During this fight the *Gloucester* was under the fire of the Socapa battery. Within twenty minutes from the time they emerged from Santiago harbor the careers of the *Furor* and *Pluton* were ended and two-thirds of their people killed. The *Furor* was beached and sunk in the surf; the *Pluton* sank in deep water a few minutes later. The

destroyers probably suffered much injury from the fire of the secondary batteries of the battleships *Iowa*, *Indiana*, and *Texas*, yet I think a very considerable factor in their speedy destruction was the fire, at close range, of the *Gloucester's* battery. After rescuing the survivors of the destroyers, the *Gloucester* did excellent service in landing and securing the crew of the *Infanta Maria Teresa*.

The following is Captain Wainwright's modest report:

REPORT OF LIEUTENANT COMMANDER
RICHARD WAINWRIGHT, CAPTAIN
U.S.S. *Gloucester*
Off Santiago de Cuba, Cuba,
July 6, 1898.

SIR:

1. I have the honor to report that at the Battle of Santiago on July 3 the officers and crew of the *Gloucester* were uninjured and the vessel was not injured in hull or machinery, the battery only requiring some slight overhauling. It is now in excellent condition.

2. I enclose herewith a copy of the report of the executive officer, made in compliance with paragraph 525, page 110, Naval Regulations, which report I believe to be correct in all particulars. I also enclose copies of the reports of the several officers which may prove valuable for future reference.

3. It was the plain duty of the *Gloucester* to look after the destroyers, and she was held back, gaining steam, until they appeared at the entrance. The *Indiana* poured in a hot fire from all her secondary battery upon the destroyers, but Captain Taylor's signal, "Gunboats close in," gave security that we would not be fired on by our own ships. Until the leading destroyer was injured, our course was converging necessarily; but as soon as she slackened her speed, we headed directly for both vessels, firing both port and starboard batteries as the occasion offered.

4. All the officers and nearly all the men deserve my highest praise during the action. The escape of the *Gloucester* was due mainly to the accuracy and rapidity of the fire. The efficiency of this fire, as well as that of the ship generally, was largely due to the intelligent and unremitting efforts of the executive officer, Lieutenant Harry P. Huse. The result is more to his credit when it is remembered that a large proportion of the officers and men were untrained when the *Gloucester* was commissioned. Throughout the action he was on the bridge and carried out my orders with great coolness. That we were able to close in with the destroyers, and until we did so they were not seriously injured, was largely due to the skill and constant attention of Passed Assistant Engineer George H. McElroy. The blowers were put on and the speed increased to seventeen knots without causing a tube to leak or a brass to heat. Lieutenant Thomas C. Wood, Lieutenant George H. Norman, Jr., and Ensign John T. Edson, not only controlled the fire of the guns in their divisions and prevented waste of ammunition, but they also did some excellent shooting themselves. Acting Assistant Surgeon J. F. Bransford took charge of one of the guns and fired it himself occasionally. Acting Assistant Paymaster Alexander H. Brown had charge of the two Colt guns, firing one himself, and they did excellent work. Assistant Engineer A. M. Procter carried my orders from the bridge and occasionally fired a gun when I found it was not being served quite satisfactorily. All were cool and active at a time when they could have had but little hope of escaping uninjured.

5. Lieutenants Wood and Norman, Ensign Edson, and Assistant Engineer Procter were in charge of the boats engaged in saving life. They all risked their lives repeatedly in boarding and remaining near the two destroyers and the two armored cruisers when their guns were being discharged by the heat and their magazines and boilers were exploding. They also showed great skill in landing and taking off the prisoners through the surf.

6. Of the men mentioned in the several reports I would call especial attention to John Bond, chief boatswain's mate. He would have been recommended to the Department for promotion prior to his gallant conduct during the action of July 3. I would also recommend to your attention Robert P. Jennings, chief machinist, mentioned in the report of Mr. McElroy. I believe it would have a good effect to recognize the skill of the men and the danger incurred by the engineer's force. I would also recommend that the acting appointments of those men mentioned by the officers in their reports be made permanent.

7. The wounded and exhausted prisoners were well and skillfully tended by Assistant Surgeon Bransford, assisted by Ensign Edson, who is also a surgeon.

8. The Admiral, his officers, and men, were treated with all consideration and care possible. They were fed and clothed as far as our limited means would permit.

Very respectfully,
RICHARD WAINWRIGHT,
Lieutenant Commander, U.S.N., Commanding.
To the Commander-in-Chief, U. S. Naval Force, North Atlantic Station.

The battle was over—that is, the *Gloucester's* own part of it was finished—although our other ships drove on at full speed, firing at the fleeing Spanish cruisers and finally ended by driving them ashore one by one in a battered and sinking condition. An armed yacht, a gunboat by courtesy, the *Gloucester* had destroyed in a fair fight two enemy torpedo boats in the almost unbelievable time of twenty minutes. The *Pluton* and *Furor's* losses in killed and drowned were two-thirds the people on board. The *Gloucester's* loss was exactly zero. No one was even wounded, that is, unless you can call Ensign Edson's two broken ribs, caused by the kick of one of his 3-pounders, a wound. History records no victory like this.

The echoes of the *Gloucester's* guns had not stopped returning from the mountainous

shores of Santiago, when the word was passed, "Away all boats," and the same officers and men who a few minutes before had the one thought of annihilating their enemy, shoved off. The dinghy under Lieutenant Thomas Wood and the whaleboat under Lieutenant George H. Norman headed for the *Furor,* now dangerously close to sinking, under orders from Captain Wainwright to rescue as many Spanish survivors as possible and to salvage the enemy ship if at all practicable. On boarding the *Furor* the *Gloucester's* officers and men were met with scenes of death and destruction. Dead and mangled men lay about the decks. The *Furor* was riddled with 3-pounder and 6-pounder shell holes, but as Lieutenant Wood stated, "There was no evidence of shots of larger caliber." The *Furor* was burning fiercely from stem to stern, her ammunition was exploding, and altogether she was a far more dangerous enemy after surrendering than she had been in battle. The rescuers barely had time to take off the survivors before she reared her bow in the air and sank. Lieutenant Wood captured her colors. One of the *Gloucester's* boats, under Lieutenant Wood, then rowed to the beach to continue rescue work on the *Pluton,* now pounding on the rocks with flames bursting from every port and hatch. Rescue here was more difficult and dangerous even than in the case of the *Furor.* Meanwhile the gig, under Lieutenant Norman, and the cutter under Ensign Edson, proceeded to the burning *Infanta Maria Teresa,* pounding on the rocks a few hundred yards to the westward. She, too, was on fire and her survivors had crowded up together on the forecastle, unable to save themselves and afraid to jump overboard. Ensign Edson got a line ashore from the *Teresa* and with Lieutenant Norman's boat, used this to haul their boats, loaded with Spaniards, through the surf to a point near the shore, and discharged their cargoes by throwing the enemy sailors overboard and returning for another load. In this way, 480 members of the *Teresa's* crew were saved. Among them were Admiral Cervera and his son, Lieutenant Angel Cervera. All were in a wretched condition. The Admiral, wringing wet, clothed only in trousers and undershirt, and standing on the beach surrounded by his forlorn shipmates, formally (or as formally as he could under the circumstances) surrendered to Lieutenant Norman. The Admiral and his officers and many of his crew were rowed to the *Gloucester,* where Captain Wainwright gave them every honor and comfort.

Among others rescued by the *Gloucester* were Commander Carlier, the *Furor's* captain, Commander Vasquez, captain of the *Pluton,* Lieutenant Arderious of the *Furor,* and Lieutenant Boardo of the *Pluton.* Flotilla Commander Captain Villaamil was struck by a shell from the *Gloucester's* guns and was instantly killed.

With the completion of the rescue, the *Gloucester's* work was done. Sunday, July 3, begun so peacefully with all hands in clean white mustering clothes, had changed swiftly into a day of battle. It ended peacefully too, and solemnly. The crew of the *Gloucester* were not to turn in their hammocks until they had looked on the most awe-inspiring scene that man-of-war's men may ever see. The log of July 3 reads:

> 6-8 P.M. At 7:15 called "all hands to bury the dead" and consigned dead Spanish prisoner to his grave.
>
> (Signed) THOMAS C. WOOD,
> *Lieutenant, U. S. Navy.*

This unknown Spanish sailor of the *Furor* followed his ship to the bottom, but he was wrapped in a shroud of honor—the captured colors of the *Furor.* Gallant *Gloucester!*

The crew then turned in. They had nothing to worry about now—nothing except when they would get liberty in New York. The day ended as follows, according to the log:

> 8-12 P.M. Lying off Morro. Weather pleasant. Bright moonlight.
>
> (Signed) G. H. NORMAN,
> *Lieutenant, U. S. Navy.*

Fine way for the *Gloucester* to end the day.

Experimental High Frequency Radio Tests *for* Aircraft

By LIEUTENANT W. H. HOFFMAN, *U.S.N.R.*, and
LIEUTENANT COMMANDER F. H. SCHNELL, *U.S.N.R.**

EARLY in April, 1927, we decided to make a small practical radio receiver for use in an airplane. The idea was to make tests on short wave lengths to see just how badly the ignition would interfere without shielded ignition leads from the magneto to the spark plugs of the motor. We realized that such a receiver must be one of minimum weight, compact, and yet show a performance that would compare favorably with the average good table model receiver.

This receiver was finished May 23. It weighed less than nine pounds. The entire receiver was mounted in a shielding case of aluminum, which measured eight inches wide, seven and three-quarters of an inch high and four and three-quarters of an inch in depth. Filament batteries consisted of three number 2370 Burgess "C" (four and one half volts) batteries connected in parallel to heat the filaments of the CX-299 tubes, the current consumption of which is sixty milliamperes per tube, or one hundred and eighty milliamperes for the three of them, there being a detector and two audio stages of amplification. Plate supply batteries consisted of two number 4156 Burgess "B" (twenty-two and one-half volts) batteries connected in series. Batteries also were mounted in the same case, the receiver, proper, in the upper compartment and all batteries in the lower one.

Four interchangeable coils were made to cover the wave length range from about fifteen meters to ninety-two meters. These coils were wound on the bases of discarded CX-301A tubes, the four prongs being used for terminal contacts which made connections to the two secondary and regeneration control terminals brought up to the socket. The circuit is the standard regeneration control which has been the amateur's stand-by since 1915. Any circuit that can stand up for thirteen years and still be the favorite of ninety-nine per cent of the radio amateurs must be a pretty good circuit. This is all the more impressive when consideration is given to the fact that the untiring efforts of some fifteen or twenty thousand radio amateurs for years and years have been given to develop something better. When Paul Godley gave the amateur world the idea of regeneration on wave lengths around 200 meters, little did he or anybody else realize that it would stand this most acid test of time and effort.

Of course, the airplane receiver was tested to see that it would function properly before it was installed in a plane. Mounted on a desk in the office of the radio laboratory and with the receiver cord of the line telephone for an antenna pick-up, signals were heard. Our log shows that we heard PQW, a station in Germany, transmitting to SPU on a wave length of about sixteen meters. That was the greatest distance over which signals were heard and this happened at twelve minutes to two o'clock C.S.T. on the afternoon of May 26. When further tests were made, dozens and dozens of short wave signals were heard.

Finally, June 13, we installed the receiver in the cockpit of the Waco airplane at Pennco Field in Madison, Wisconsin. The plane had a Curtis OX-5 motor. We had hopes of hearing signals from our own 500 watt short wave transmitter at 9EK, providing we did not fly more than a mile or two away from the transmitter. The plane was in the air fifteen minutes and even before the plane came to a stop after landing we

*C. F. Burgess Laboratories, Inc., Madison, Wisconsin.

knew that Phil Zurian had heard signals—the broad smile was the telltale. Signals were of maximum strength and in spite of our knowledge that the greatest distance the plane flew from the transmitter was not more than two miles, our enthusiasm jumped up several points. Station 9EK transmitted on a wave length of 38.4 meters.

The same receiver was again tested June 26, in a flight from Washington, D.C., to Pittsburgh, Pennsylvania, in an airplane of the Navy Department. Mr. C. W. Horne, of KDKA, Westinghouse Electric and Manufacturing Company, kindly coöperated by transmitting both voice and code on a wave length of about sixty-three meters during the flight. Not a peep was heard nor on the return flight next day, although attempts were made to hear signals on the forty and eight meter bands of wave lengths. This was rather discouraging in some measure, yet there was no interference from ignition, one of the biggest bugaboos in reception in a plane. The Army and Navy have done extensive experimental work in connection with shielding to prevent ignition interference.

In the course of time the little transmitter, weighing less than five pounds, exclusive of dry batteries, was completed and ground tested before it was taken into a plane. September 21 we installed the transmitter and receiver in the *Air King*, at Madison airport, and using a trailing wire antenna about seventy feet long established two-way communication with 9EK for the first time on seventy-nine meters. The airplane used our experimental call, 9XH. Communication was perfect for a distance of seventeen miles.

Don Mix, MacMillan's first radio operator to accompany him to Etah, North Greenland, was next in line for an airplane test which took place September 30. This, too, was in the *Air King* with the Curtis OX-5 motor. After reaching a distance of about forty-five miles, during which time communication was maintained with 9EK, the *Air King* was running low on gas, necessitating an immediate return from Wales, Wisconsin, against a head wind. Signals from the plane were remarkably steady in frequency during the entire flight although there was some slight fading at times. The altitude during these flights was between one and two thousand feet.

October 4, we made further tests, especially to learn if higher altitudes would show different results. Accordingly, the plane took off and flew some thirty miles south, climbing all the time until an altitude of 6,400 feet was reached. Way up above the clouds where we could not hear the motor nor see the plane, we knew Phil Zurian was there because we maintained communication with him. It was on this day we first tasted greater distance when we heard two amateurs calling the plane, 9XH. One was 9CLW, Danville, Illinois, and the other was 9DGW, Goldfield, Iowa, distances of about 250 miles. Station 9CLW reported signals r-4, while 9DGW reported r-7, both strong signal reports. Such reports were extremely encouraging, considering the power of the airplane transmitter which is about four watts, one fifteenth of the power used in the average electric light bulb.

Then came slight changes on the transmitter when some means of adding voice were carried out. Ever realizing that additional weight in the radio equipment would mean that much less in pay load, we did add a voice transmitter with practically no additional weight. Not the most efficient, but something to start on for preliminary tests. Although we used dry batteries for plate and filament supply, the best supply that can be obtained, we hardly thought it possible that voice signals would come through with any clarity because of the vibration of the transmitter caused by the airplane. We knew this, because when using code, the signals had considerable modulations due to the vibration and we were somewhat skeptical about results.

The only way to find out was to try it, which we did on October 21. When Zurian said he was going to change over and use voice, we held our breath only to heave a sigh of relief when Zurian started in with, "Hello, 9EK; hello, Hoff, this is the Burgess Flying Radio Laboratory flying over Madison, Wisconsin." And for fifteen miles we kept up a running conversation, 9EK using code in reply to Zurian's voice. Encouraging, to say the least.

The big test came October 22 when we were going after real distance. We had enlisted the coöperation of radio amateurs of the American Radio Relay League and they were keen and on edge for a test of

this kind. Only unforeseen things could prevent new results. The *Air King* was filled to capacity with gas and oil and we knew it would be good for several hours steady flying. Of course we picked Saturday afternoon when we knew there would be many amateurs on the air. While the airplane apparatus was being installed in the plane, another receiver was connected up at the hangar. This was used for comparison of signal strength with those received in the plane. The *Air King* left the ground at twenty-eight minutes after three o'clock with Zurian as operator. After the antenna was reeled out, there was a short preliminary test with 9EK to see that all was well. No sooner had Zurian signed off with 9EK than he picked up 9DTK, Milwaukee, Wisconsin, for the first outside contact. Station 9DTK reported signals r-7 and also handed in a very complete record of everything Zurian sent from the airplane 9XH. At twenty-two minutes to four o'clock, 9JA, Madison, Wisconsin, was communicating with 9XH. Then followed 9BBT, Cocato, Minnesota, at 3:44 P.M. Station 9EHO, Arlington, Minnesota, was next at 3:45 P.M. This operator said he could have copied every letter sent by 9XH. At 3:51 P.M., 9DCE, Milwaukee, Wisconsin, reported r-6 as did 9DBW, at Northfield, Minnesota, at 3:55 P.M. R-3 was the best he could get from 8CVQ, at Kalamazoo, Michigan. Station 9EMD, Manchester, Wisconsin, didn't give a report although communication was established with him at 4:06 P.M. We, on the ground, were a bit excited when 8CEO, Oakmont, Pennsylvania, called 9XH at 4:11 P.M. Would Zurian hear 8CEO we wondered, and hadn't finished when 9XH called 8CEO and communicated with him and received report of r-4 to r-6. Five hundred miles from and to an airplane on seventy-nine meters! And with such a small outfit! The whole outfit weighed but sixty-five pounds and was powered entirely from dry batteries.

In a report from 8CEO, Mr. McAuly, operator said:

> I consider this to be the most important test of the year in amateur radio circles. Many planes have taken off for long and dangerous trips with either no radio set at all or with a range which would render it of little value in emergencies. With a set like that used by 9XH today, arranged to use the forty and twenty meter bands as well as the eighty meter band, and working with amateurs, it would be possible, by changing from one wave to the other as distance made it necessary, to work continuously no matter where the plane might go. With such a set, a good operator, such as manned 9XH today, and the policy of working with amateur stations, airplanes need not be without communication at any time.

Next came 9QT, Minneapolis, Minnesota, with a report of r-5 at 4:15 P.M. Then 9BKV, Akron, Iowa, who reported perfect voice modulation of r-7 at 4:28 P.M. The other transmissions were key and code. At 4:33 P.M. we heard Lieutenant H. P. Roberts, U.S.A., of Wright Field, Dayton, Ohio, calling 9XH and Zurian communicated with him. Lieutenant Roberts, AW5, used his voice transmitter which was received perfectly by Zurian. Station 8AMU, Brentwood Boro, Pennsylvania, reported r-4, followed by 8EJ, Warren, Ohio, at 4:54 P.M. with r-6. The last station was 8ARC, also at Oakmont, Pennsylvania, with r-3 at 5:00 P.M. The plane landed a few minutes after five, having communicated with fifteen amateurs in six different states.

Zurian heard two amateurs in metropolitan New York and later we received reports from the following amateur stations: 9CHC, Lafayette, Indiana; 9CE, Ishpeming, Michigan; Aero Products Company, Chicago, Illinois; 9CVJ, Ashland, Wisconsin; 9CVI, South Milwaukee, Wisconsin; 9AIR, Sleepy Eye, Minnesota; 9AMG, Council Bluffs, Iowa; 8ARK, Detroit, Michigan; 9DLD, Jefferson, Wisconsin; 8BCM, Deposit, New York, 725 miles; 9ACL, Davenport, Iowa; J. H. Brager, Mount Horeb, Wisconsin; 9DSV, Davenport, Iowa. From all of the above stations came reports of reception of signals from the airplane, all being regarded as very good signal strength reports.

Two weeks later, Monday evening, November 11, a demonstration which meant night flying was put on for a technical club. A receiver and transmitter were installed at the club meeting place and although the interference was quite bothersome, the demonstration was pretty good. While Zurian was talking to the members at the meeting, an amateur in Dayton, Ohio, listened in and heard the voice transmission from the airplane. So much for the seventy-nine meter tests.

Immediately after concluding these tests,

work was started on a forty meter transmitter and receiver for airplane use. Also a low power transmitter was installed at the radio laboratory for voice and code communication with the plane. This was operated from dry battery plate supply, using a seven and a half watt vacuum tube in each socket for modulation, oscillation, and amplification. This was tested for range at no regular time of the day but just as we happened to find a few minutes here and there.

Voice communication was established with 9DYT, Ladoga, Indiana; 9EJO, Geneva, Illinois; 9DOE, St. Louis, Missouri; 9BTX, Wilmette, Illinois; 9EFZ, Franceville, Indiana, and 9AAW, Chicago, Illinois. In each case the report was very good on signal strength and reproduction or modulation.

The first forty meter airplane test was made December 6. A "Travel Air" with a Curtis OXX-6 motor was used. Zurian established communication with 8DCE who reported r-7. The voice received at 9EK was considerably better at close range than on seventy-nine meters although the test was of short duration. It was not as good at a greater distance. Another test was made December 23, in a "Travel Air" equipped with a Wright J5C whirlwind motor. It was done in haste with unsatisfactory results. Mix said the antenna fouled on a brake wire which caused the difficulty and there wasn't time to correct it before darkness came on.

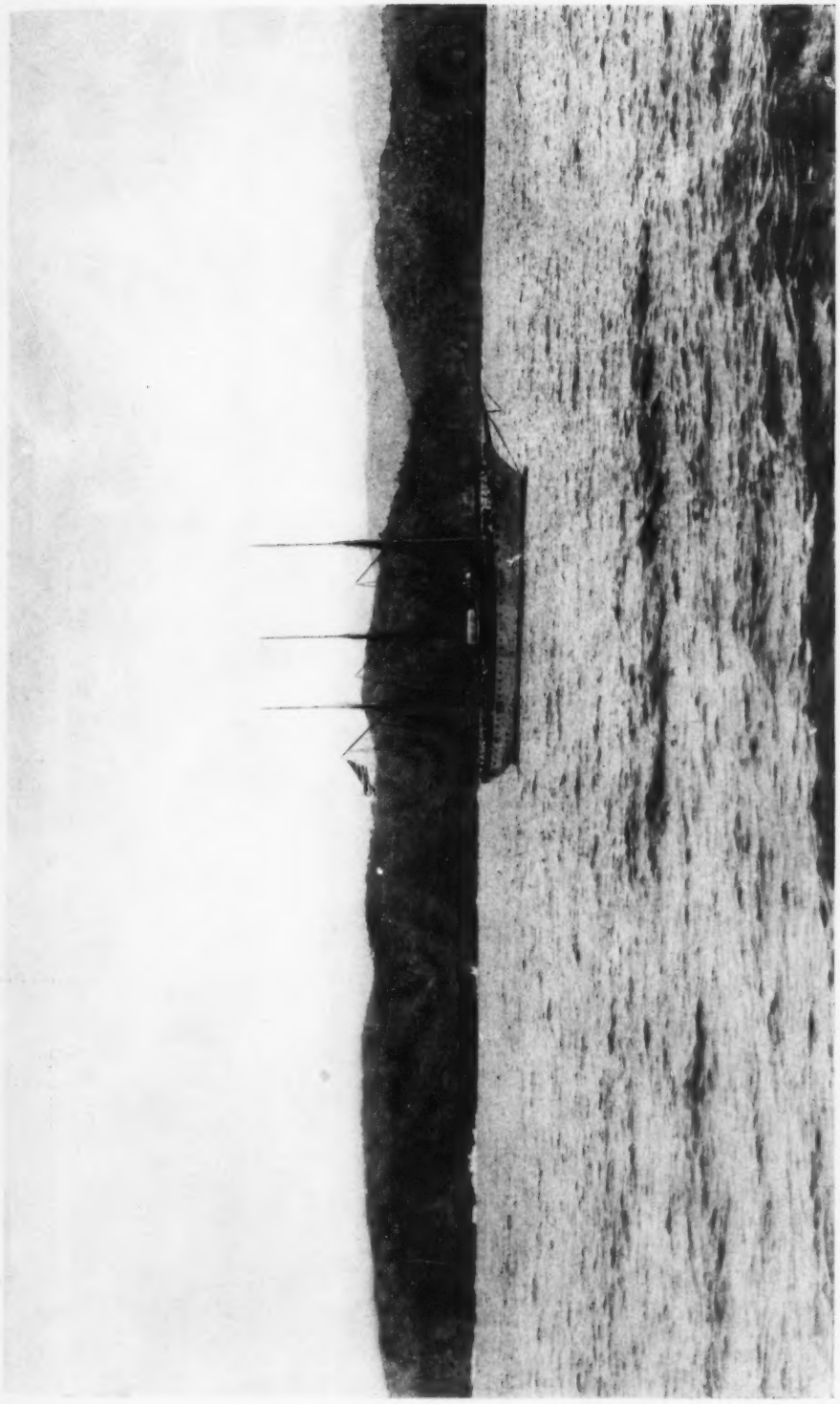
To close the year, one final forty meter test was made December 29, when Zurian, in the "Travel Air" J5C took off from Madison at 1:56 P.M. headed for Great Lakes Naval Training Station. We sent a dispatch to Great Lakes advising that the airplane would fly over the station, weather permitting, during the afternoon. Knowing that the radio station at Great Lakes would be busy with schedules, Zurian took a chance and called NAJ. We heard him call several times and finally telephoned Great Lakes and asked them to listen for 9XH because the pilot wanted to land there in order to make a test from the ground. Because this apparatus will operate on the ground, since it is powered by dry batteries, we did want to get a ground test. The pilot was unable to find the landing field at Great Lakes and although he circled around for more than a half hour, he had to go back to Milwaukee where they put in for the night.

Station 9EK maintained communication with 9XH all the way to Great Lakes and back to Milwaukee without the slightest difficulty. Zurian had to shift from one wave length to another in order to keep an ear out for 9EK and NAJ. He heard NAJ, but NAJ did not hear 9XH. The plane left Milwaukee next morning and communication was maintained with 9EK until the plane landed at Madison Airport shortly after ten o'clock. Immediately after landing, the antenna was reeled out above the ground about three feet when two-way communication was established with 9CPH, Peoria, Illinois, who reported signals r-6, pure d.c.

The results of these tests should in no way be regarded as conclusive. They do point the way and may be used as a basis for those who are interested in airplane radio.

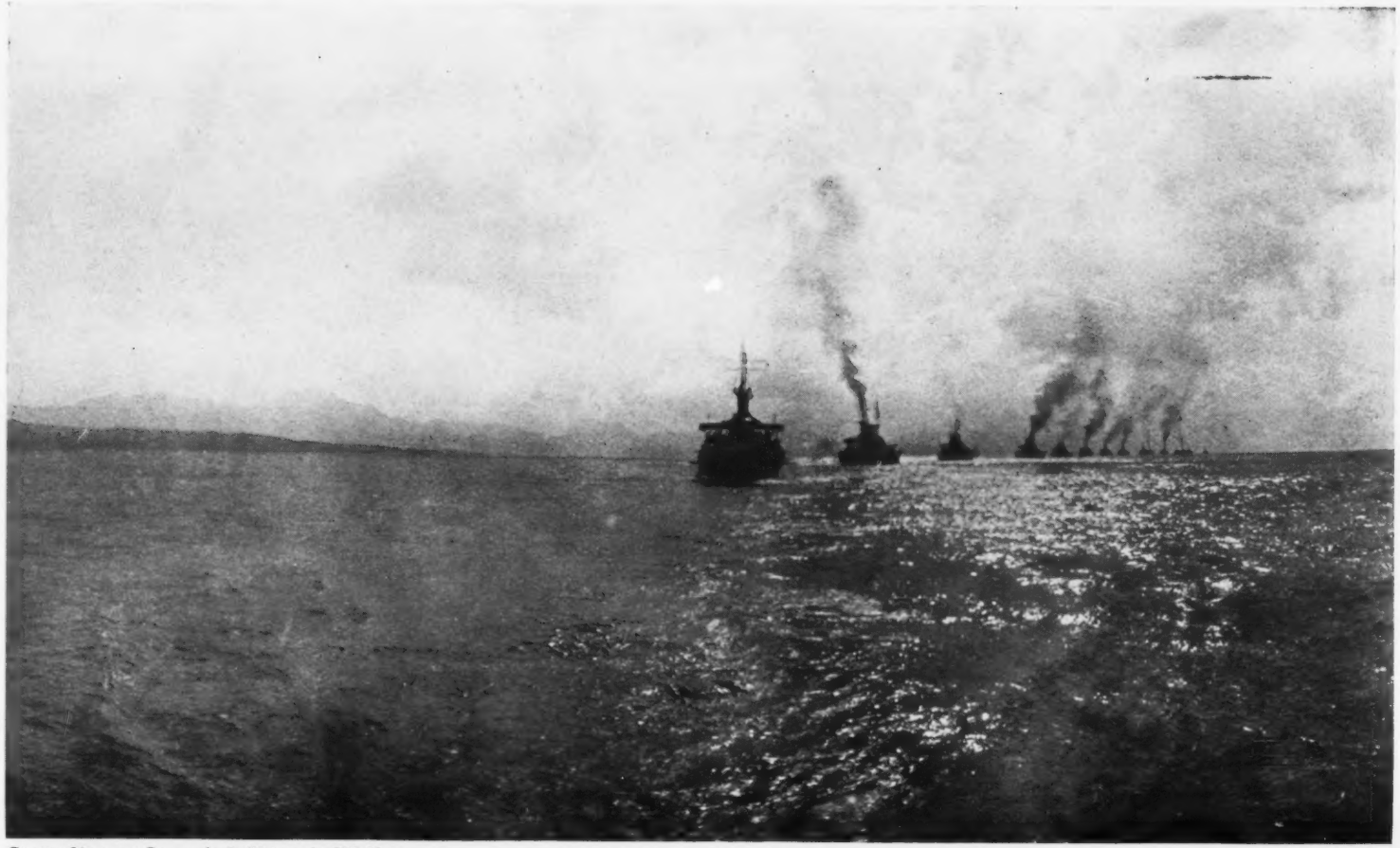
Fiction, fad, or fancy—there is belief in some quarters that some day airplanes and airports will be equipped with short wave radio transmitters and receivers. The time seems close at hand, yet time alone will tell. Whether it be passenger, mail, or express plane, communication may be regarded as highly desirable if not as important and necessary as communication with ships at sea. The factor of safety is considerably increased when weather reports, flying conditions, and landing field conditions are available to the pilot of an airplane. Surely, the additional weight of a reliable, compact, and easily operated radio set is justified by the insurance of the safety of the airplane, not to mention the life of the pilot and perhaps the passengers.

Such radio apparatus, to be considered at all, becomes the wrist watch of the radio family, yet it must do what is expected of the huge and cumbersome grandfather's clock. It may be the means of preventing serious, if not fatal disaster.



Courtesy Lieutenant Commander R. Wainwright, U.S. Navy

U.S.S. *ANNAPOLIS* OFF PAGO PAGO, SAMOA, WELCOMES THE U.S. ATLANTIC FLEET IN AUGUST, 1908

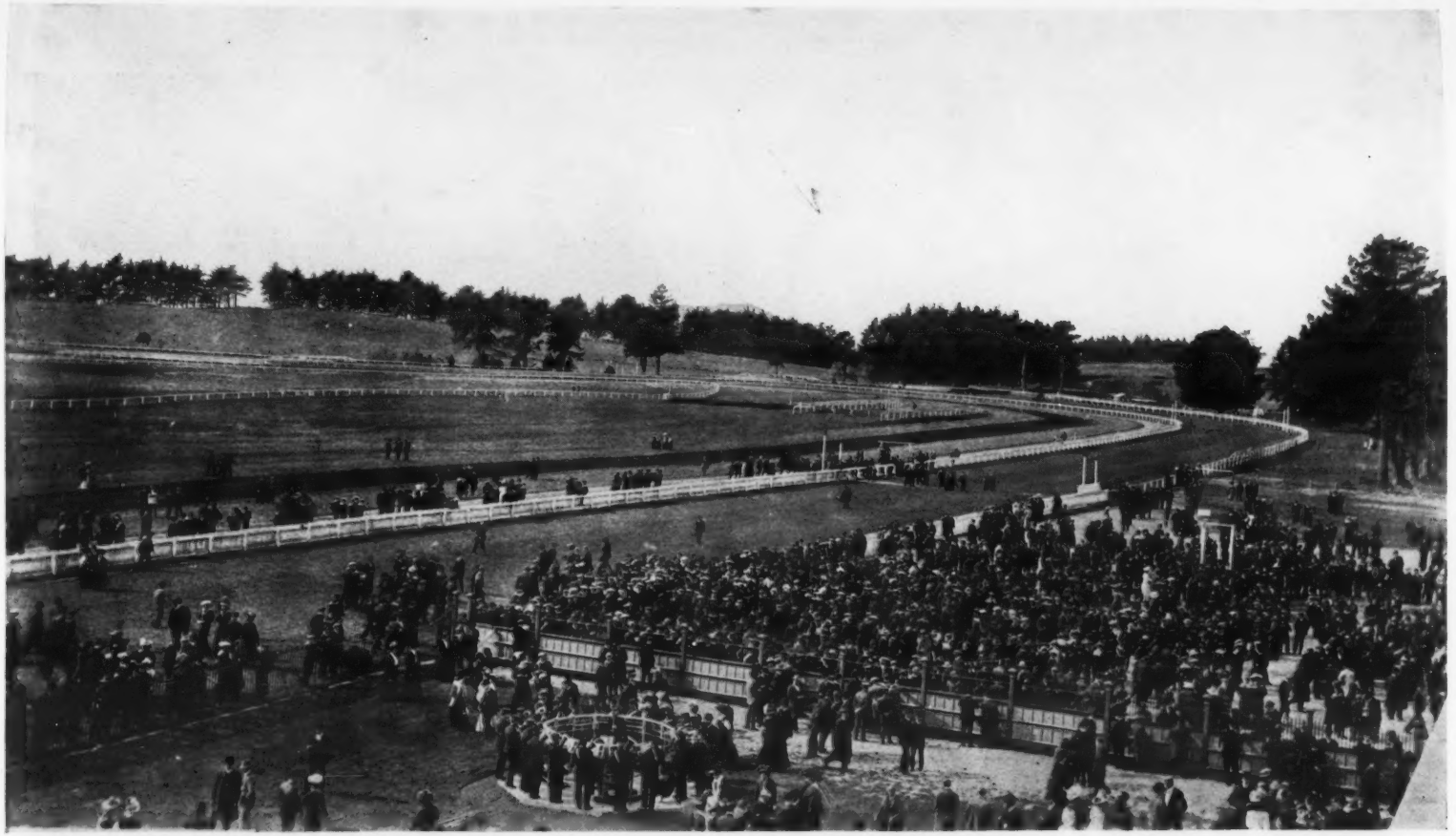


Courtesy Lieutenant Commander R. Wainwright, U.S. Navy

U.S. BATTLESHIPS PASSING PAGO PAGO, AMERICAN SAMOA, 1908
The fleet passed close enough to shore for the people to see the mighty armada.

Courtesy Lieutenant Commander R. Wainwright, U.S. Navy

U.S. BATTLESHIPS PASSING PAGO PAGO, AMERICAN SAMOA, 1908
The fleet passed close enough to shore for the people to see the mighty armada.



Courtesy Lieutenant Commander R. Wainwright, U.S. Navy

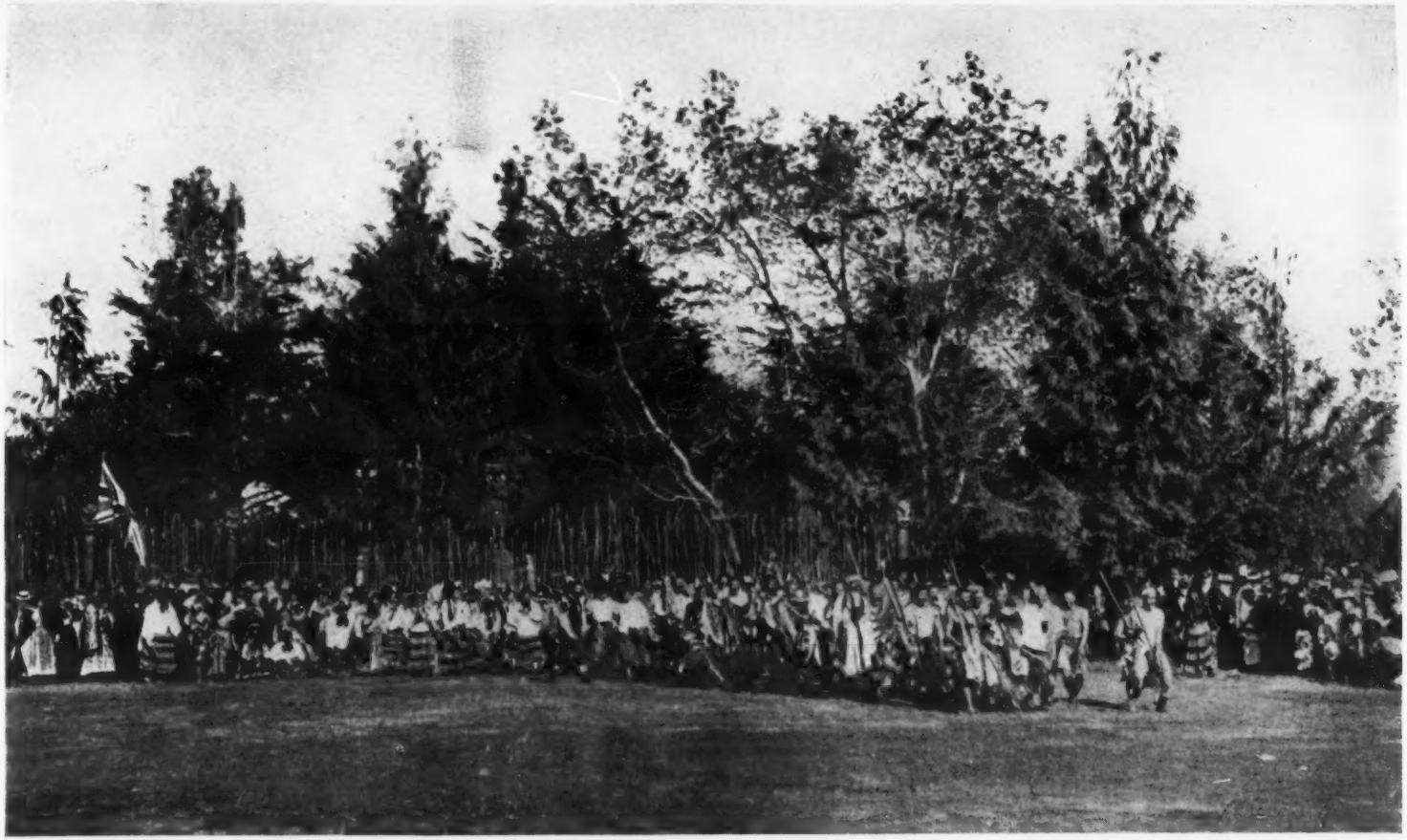
RACE TRACK AT ELLORSLIE, NEW ZEALAND (NEAR AUCKLAND)
Races for officers and men of the U.S. Atlantic fleet in 1908.

Courtesy Lieutenant Commander R. Wainwright, U.S. Navy

MAORI MEETING HOUSE, ROTORUA, NEW ZEALAND
Party of officers from the fleet in 1908.

Courtesy Lieutenant Commander R. Wainwright, U.S. Navy

MAORI MEETING HOUSE, ROTORUA, NEW ZEALAND
Party of officers from the fleet in 1908.



Courtesy Lieutenant Commander R. Wainwright, U.S. Navy

THE ARAWA TRIBE OF MAORIS DEBOUCHING FROM THEIR STOCKADE TO GREET ADMIRAL SPERRY AND PARTY OF U.S. NAVAL OFFICERS, ROTORUA, NEW ZEALAND 1908

Courtesy Lieutenant Commander R. Wainwright, U.S. Navy

CHIEF OF ARAWA TRIBE MAKING SPEECH OF WELCOME TO ADMIRAL SPERRY AT ROTORUA, NEW ZEALAND, IN 1908

Courtesy Lieutenant Commander R. Wainwright, U.S. Navy

CHIEF OF ARAWA TRIBE MAKING SPEECH OF WELCOME TO ADMIRAL SPERRY AT ROTORUA, NEW ZEALAND, IN 1908

Courtesy Lieutenant Commander R. Wainwright, U.S. Navy

MAORI CHIEF PRESENTING TO ADMIRAL SPERRY A ROBE DECORATED WITH FEATHERS OF THE MOA, AN EXTINCT BIRD.
ROTORUA, NEW ZEALAND, 1908

Courtesy Lieutenant Commander R. Wainwright, U.S. Navy

THE ARAWA TRIBE OF ROTORUA, NEW ZEALAND IN THEIR NATIVE COSTUME, READY FOR THE *HAKA* IN HONOR OF ADMIRAL SPERRY AND OFFICERS OF THE U.S. FLEET .1908

Courtesy Lieutenant Commander R. Wainwright, U.S. Navy

THE ARAWA TRIBE OF ROTORUA, NEW ZEALAND IN THEIR NATIVE COSTUME, READY FOR THE *HAKA* IN HONOR OF ADMIRAL SPERRY AND OFFICERS OF THE U.S. FLEET, 1908

Courtesy Lieutenant Commander R. Wainwright, U.S. Navy

MAORI *HAKA* (NATIVE DANCE) FOR OFFICERS OF THE U.S. FLEET AT ROTORUA, NEW ZEALAND, 1908

Courtesy Lieutenant Commander R. Wainwright, U.S. Navy

MAORI HAKA, 1908

Many of the Maoris in this picture came to this country about 1910 and performed at the Hippodrome, New York City.

Courtesy Lieutenant Commander R. Wainwright, U.S. Navy

MAORI HAKA, 1908

Many of the Maoris in this picture came to this country about 1910 and performed at the Hippodrome, New York City.

Courtesy Lieutenant Commander R. Wainwright, U.S. Navy

MAORI WOME DANCING

Rotorua, New Zealand, 1908

Courtesy Lieutenant Commander R. Wainwright, U.S. Navy

ANOTHER VIEW, SHOWING TRIBAL COSTUMES
Rotorua, New Zealand, 1908

ANOTHER VIEW, SHOWING TRIBAL COSTUMES
Rotorua, New Zealand, 1908

Courtesy Lieutenant Commander R. Wainwright, U.S. Navy

SIGHTSEEING, ROTORUA, NEW ZEALAND, 1908
Officers of the fleet operating on shore.

International Newsreel

MAORI CARVED GATEWAY, ROTORUA, NEW ZEALAND

International Newsreel

MAORI WANA

The language and types indicate that the Hawaiians and Maoris are of kindred origin.

DOUBTFUL SOUND, SOUTHLAND, NEW ZEALAND
Southern New Zealand has some of the most beautiful scenery in the world.

International Newsreel

DOUBTFUL SOUND, SOUTHLAND, NEW ZEALAND
Southern New Zealand has some of the most beautiful scenery in the world.

Cylindrical Slide Rules *for* Aviators *and* Navigators

By Captain Armistead Rust, *U. S. Navy (Retired)*

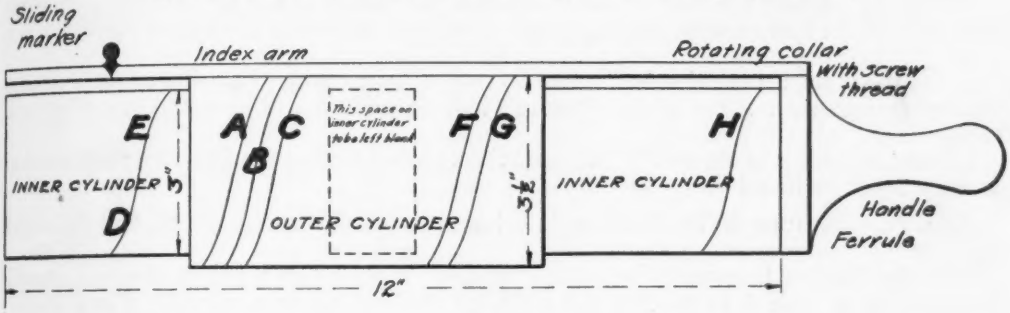


Fig. 1

Fig. 1 shows Rule I for computing the zenith distance for the "Marcq Saint-Hilaire" method, and consists of seven parts:

1. The outer cylinder.
2. The inner cylinder.
3. The rotating collar.
4. The ferrule.
5. The index arm.
6. The sliding marker.
7. The handle.

1–2, the outer cylinder slides back and forth on the inner cylinder with a snug fit.

3–4, the rotating collar and the ferrule are fitted with about a turn and a half of a screw thread of the same pitch as that of the spiral scales on the two cylinders.

5–6, the index arm is attached to the rotating collar so that its left edge will be parallel to the elements of the cylinders so that it may be placed in a plane passing through the common axis of the two cylinders, in order that when the index arm is set on a reading on one cylinder the corresponding reading may be obtained from the other cylinder. The sliding marker, when properly set, shows the exact point on the scale on the outer cylinder from which the scale is read.

The scales used on Rule I are shown in Fig. 2. The length of these scales, when developed into straight lines, must be proportional to the outer diameters of the outer and inner cylinders in order that when laid off spirally around the cylinders at the same pitch they may preserve the proper alignment.

Description of Scales *A*, *B*, *C*, *D* and *E*

A is a scale of log haversines with the corresponding hours and minutes.

B is a scale of natural haversines corresponding to the log haversines of equal angles on scales *A* and *C* and may be used with either of the scales, *A* or *C*, to find the angles in hours and minutes or degrees and minutes, corresponding to any given natural haversine, or to find the natural haversine corresponding to any given angle.

C is the same as scale *A* with the corresponding degrees and minutes.

D is a scale of log cosines with the corresponding degrees and minutes.

E is a scale of log secants with the corresponding degrees and minutes.

Scale *A* may be dispensed with if the hour angle be converted into degrees and minutes, thereby saving some space on the outer cylinder which would allow the scales to be longer,

though with scale *A* the rule will be more convenient. This is a matter for the aviators to decide.

To Compute the Zenith Distance

Let L = latitude, d = declination, t = hour angle, θ = the usual auxiliary angle, and z = the computed zenith distance.

Formula (1) $$\frac{\text{hav } \theta}{\cos d} = \frac{\text{hav } t}{\sec L}$$

Referring to Fig. 2:

1. Set the index arm to the latitude on the inner cylinder by revolving the collar until the left hand edge of the index arm coincides exactly with the latitude on scale *E*.
2. Next by turning the outer cylinder, holding the handle in the right hand, set the left hand edge of the index arm to the hour angle on scale *A* and move the sliding marker to this point.
3. Set the index arm to the declination on scale *D* by rotating the collar and the marker will indicate on scale *A* the point opposite which on scale *B* will be found hav θ (natural haversine θ).
4. From scale *B* take the hav $(L+d)$; add this to hav θ for hav z and opposite this number on scale *B* will be found z on scale *C*.

Example.—Latitude 40°N., hour angle 2 hrs. 40 min., declination 30°N., find the zenith distance.

Take the distance between 30° on scale D and 40° on scale E in a pair of dividers, transfer this distance to scale A by placing the right leg at 2 hrs. 40 min. on scale A and the left leg will indicate the nat hav $\theta = 0.0774$ on scale B. As M. Z. D. = L − d = 10° is not found on the portion of scale C given, take it from the tables = 0.0076, and nat hav $z = 0.0850$, from scale C we find $z = 33°58'$. The value computed by logarithms is $33°56'30''$. As the slide rule from which scales A, B, C, D and E were taken was only 30 inches long, it is readily seen that with the cylindrical rule the computation may be made with great precision.

Description of Scales *F*, *G*, and *H*

F is a scale of log sines with the corresponding hours and minutes.

G is a scale of log sines with the corresponding degrees and minutes.

H is a scale of log secants with the corresponding degrees and minutes.

As in the case of scale *A*, *F* may be dispensed with if it is desired to save space on the outer cylinder.

Formula (2) $$\frac{\sin t}{\sec d} = \frac{\sin Z}{\sec h}$$

in which Z = the azimuth of the observed body and h = its true altitude.

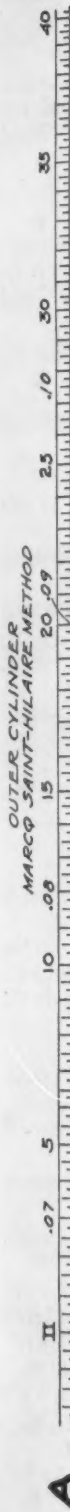
To Compute the Azimuth

Given the hour angle, declination and altitude.

1. Set the index arm to the declination, d, on scale *H* on the inner cylinder.
2. Turn the outer cylinder and set the hour angle, t, to the left hand edge of the index arm, scale *F*, outer cylinder, and move the marker to this point.
3. Revolve the collar and set the index arm to the true altitude, h, on scale *H*.
4. The marker will designate the point on scale *F* opposite which on scale *G* will be found the azimuth.
5. Name the azimuth as directed below.

Example.—In latitude 26°S., hour angle 3 hrs. 00 min, West, declination 15°N., true altitude 30°, find the azimuth.

Take the distance on scale *H* between 15° and 30° on a pair of dividers; transfer this to scale *G* by placing the left leg at 45° and the right leg will show the azimuth, 52°, on the same scale. By precept 4, below, this is marked N. 52° W.



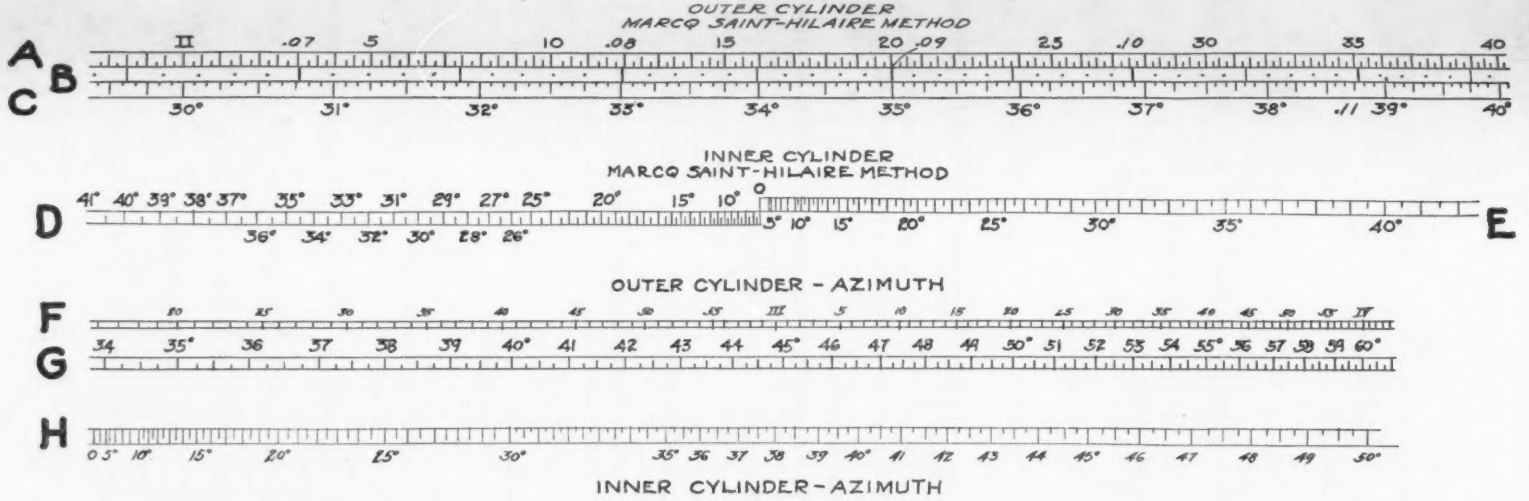


FIG. 2

Note: The scales shown in Fig. 2 and Fig. 5 are not sufficiently accurate for exact results as here reproduced, but are given to illustrate the method.

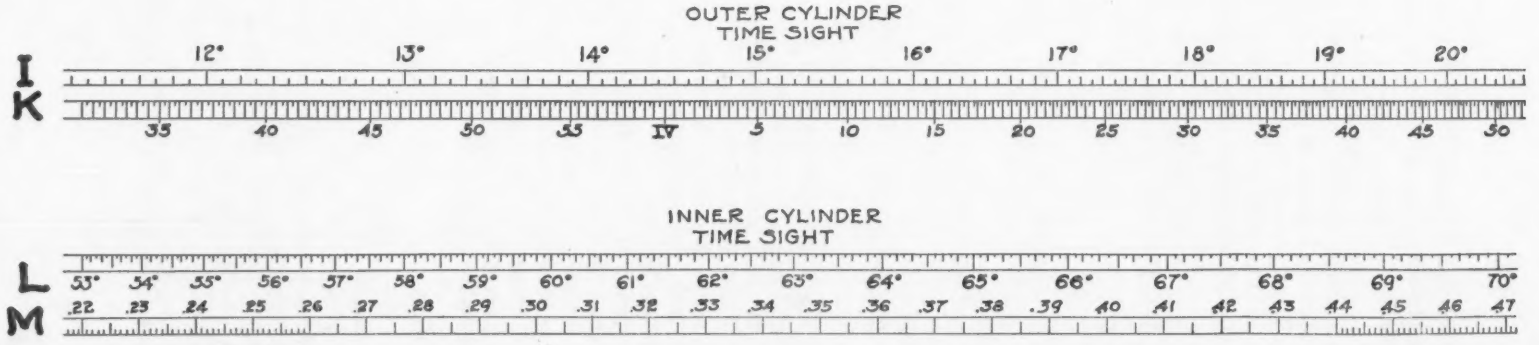


FIG. 5

TO IDENTIFY AN UNKNOWN STAR

Given the latitude, L, the true altitude, h, and the azimuth, Z, of an unknown star, to find its declination, d, and hour angle, t, and from the local sidereal time the right ascension of the star.

TO FIND THE STAR'S DECLINATION

Let β be an auxiliary angle and p the polar distance.

1. Set the index arm to L on scale E.
2. Turn outer cylinder and set index arm to Z on scale C, move marker to this point.
3. Rotate collar and set index arm to h on scale D, and the marker shows the point on scale C opposite which on scale B read nat hav β. Find the nat hav $(L \sim h)$ from scales C and B.
4. Nat hav β + nat hav $(L \sim h)$ = nat hav p; find p from scales B and C.
5. When $p < 90°$, d has the same name as the latitude, and $d = 90° - p$.
6. When $p > 90°$, d has the contrary name to the latitude and $d = p - 90°$.

TO FIND THE STAR'S HOUR ANGLE

1. Set the index arm to h on scale H.
2. Turn outer cylinder and set index arm to Z on scale G and move the marker to this point.
3. Rotate collar and set index arm to d on scale H, then the marker will show the point on scale G opposite which on scale F find the hour angle, t.

Apply the hour angle to the local sidereal time and find the right ascension of the star; thus we have the right ascension and the declination to determine the star observed.

NAMING THE AZIMUTH

1. Mark the azimuth E. or W. according to whether the observed body is east or west of the meridian of the observer.
2. When $L = 0°$ give the azimuth the same name as the declination.
3. When the latitude and the declination are of the same name and the latitude is less than the declination, the azimuth has the same name.
4. When the latitude and the declination are of contrary names, the azimuth has the name of the declination.
5. When the latitude and the declination have the same name, and the declination is less than the latitude, the body will cross the prime vertical. When it is between the P. V. and the elevated pole, that is, when its hour angle is greater than the hour angle on the P.V., the azimuth will have the same name as the latitude. When the body is between the P. V. and the equator, that is, when its hour angle is less than t_v, the hour angle on the P. V., the azimuth will have the contrary name to the latitude.

The hour angle on the P. V. may be found with Plate I as shown below.

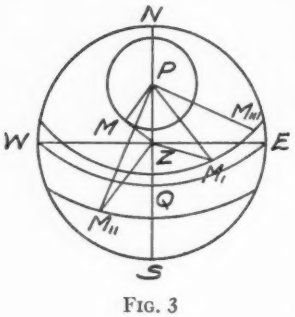


FIG. 3

The reasons for the above rules will be seen from an examination of Fig. 3, which shows the celestial sphere projected on the plane of the horizon. M, M', M'' and M''', are the positions of four bodies.

By naming the azimuths in this way we avoid the use of angles greater than 90°.

Example 1.—$L = 0°$; $t = 4^h\ 30^m$ (west); $d = 28°$ N.; $h = 20°$. Find Z. *Ans.* N. 60° 12′ W.

Example 2.—$L = 19°$ N.; $t = 4^h\ 18^m$ (east); $d = 29°$ N.; $h = 31°$. Find Z. *Ans.* N. 67° 4′ E.

Example 3.—$L = 25°$ S.; $t = 3^h\ 20^m$ (east); $d = 28°$ N.; $h = 19°$. Find Z. *Ans.* N. 45° 38′ E.

Example 4.—$L = 48°$ N.; $t = 5^h\ 55^m$ (west); $d = 28°$ N.; $h = 21°$. Find Z. *Ans.* N. 71° W.

Here $t_v = 4^h\ 6^m$ and as $t > t_v$, Z has the same name as L.

Example 5.—$L = 45°$ S.; $t = 3^h\ 10^m$ (east); $d = 26°$ S.; $h = 48°$. Find Z. *Ans.* N. 83° E.

Here $t_v = 4^h\ 3^m$ and, as $t < t_v$, Z has the contrary name.

DIAGRAM FOR THE SOLUTION OF RIGHT SPHERICAL TRIANGLES Plate I.
HOUR ANGLES ON THE PRIME VERTICAL
$\cos t_v = \cot L \tan d$

DIAGRAM FOR THE SOLUTION OF RIGHT SPHERICAL TRIANGLES

Plate I.

HOUR ANGLES ON THE PRIME VERTICAL

$\cos t_o = \cot L \tan d$

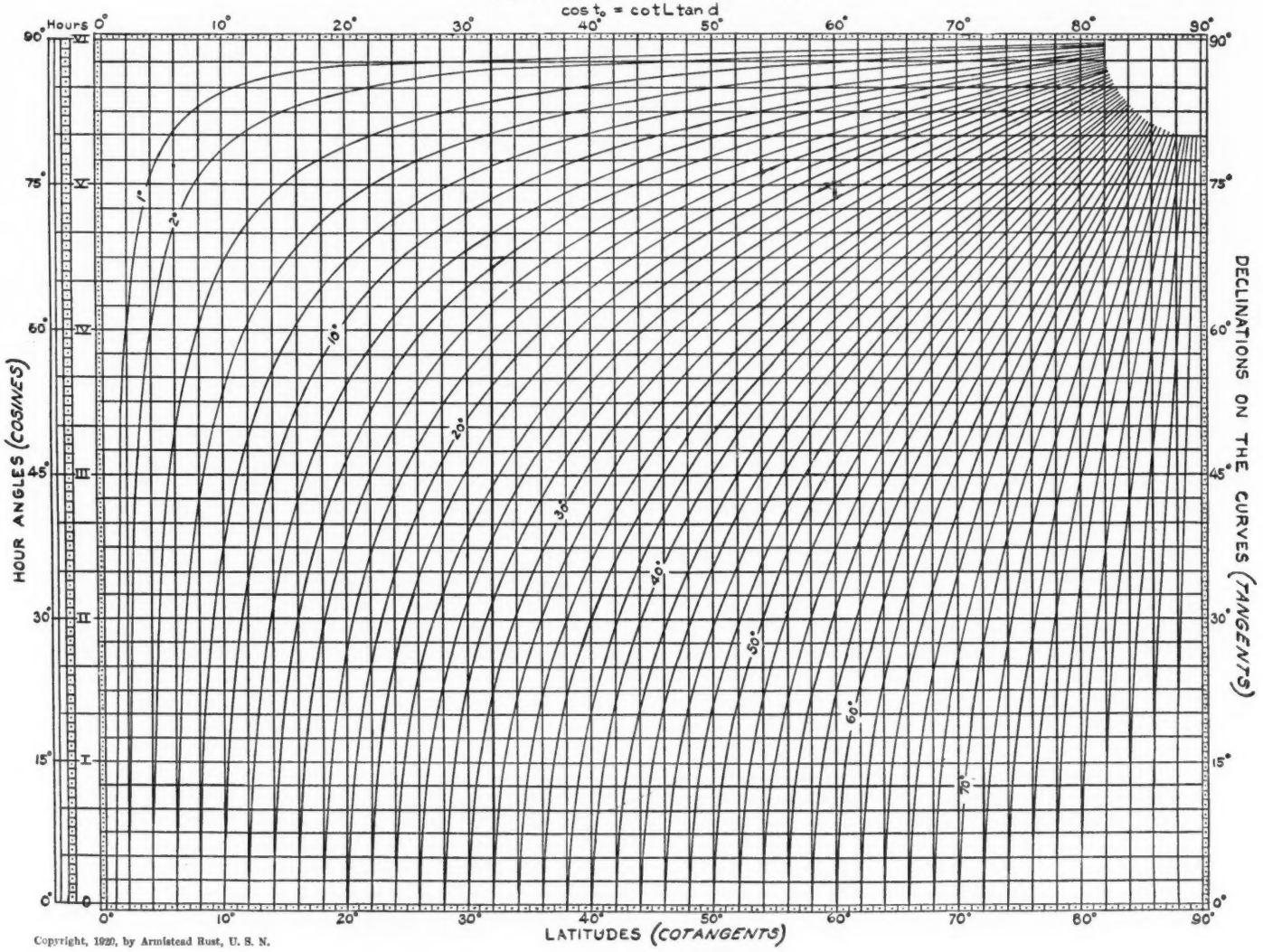


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TABLE I—LOG SECANTS AND COSECANTS

Sec.	0′	10′	20′	30′	40′	50′		Sec.	0′	10′	20′	30′	40′	50′		1′	2′	3′	4′	5′	6′	7′	8′	9′
	Enter at top for Secants						Minutes for Log Secants									Diffs. for minutes—Add								
0	0.0000	0000	0000	0000	0000	0000	89°	1°	0.0001	0001	0001	0002	0002	0002	88°	..	..	..	..	..	..	..	..	..
2	0.0003	0003	0004	0004	0005	0006	87	3	0.0006	0007	0007	0008	0009	0010	86	..	..	..	..	..	..	1	1	1
4	0.0011	0012	0012	0013	0014	0016	85	5	0.0017	0018	0019	0020	0021	0023	84	..	..	..	..	..	1	1	1	1
6	0.0024	0025	0027	0028	0030	0031	83	7	0.0033	0034	0036	0037	0039	0041	82	..	..	..	1	1	1	1	1	1
8	0.0042	0044	0046	0048	0050	0052	81	9	0.0054	0056	0058	0060	0062	0064	80	..	..	1	1	1	1	1	2	2
10	0.0066	0069	0071	0073	0076	0078	79	11	0.0080	0083	0085	0088	0091	0093	78	..	..	1	1	1	1	1	2	2
12	0.0096	0099	0101	0104	0107	0110	77	13	0.0113	0116	0119	0122	0125	0128	76	..	1	1	1	1	2	2	2	3
14	0.0131	0134	0137	0141	0144	0147	75	15	0.0151	0154	0157	0161	0164	0168	74	..	1	1	1	2	2	2	3	3
16	0.0172	0175	0179	0183	0186	0190	73	17	0.0194	0198	0202	0206	0210	0214	72	..	1	1	1	2	2	2	3	3
18	0.0218	0222	0226	0230	0235	0239	71	19	0.0243	0248	0252	0256	0261	0266	70	..	1	1	2	2	2	3	3	3
20	0.0270	0275	0279	0284	0289	0294	69	21	0.0298	0303	0308	0313	0318	0323	68	..	1	1	2	2	3	3	4	4
22	0.0328	0333	0339	0344	0349	0354	67	23	0.0360	0365	0371	0376	0381	0387	66	1	1	2	2	3	3	4	4	5
24	0.0393	0398	0404	0410	0416	0421	65	25	0.0427	0433	0439	0445	0451	0457	64	1	1	2	2	3	3	4	5	5
26	0.0463	0470	0476	0482	0488	0495	63	27	0.0501	0508	0514	0521	0527	0534	62	1	1	2	3	3	4	4	5	6
28	0.0541	0547	0554	0561	0568	0575	61	29	0.0582	0589	0596	0603	0610	0617	60	1	1	2	3	3	4	5	6	6
30	0.0625	0632	0639	0647	0654	0662	59	31	0.0669	0677	0685	0692	0700	0708	58	1	2	2	3	4	5	5	6	7
32	0.0716	0724	0732	0740	0748	0756	57	33	0.0764	0772	0781	0789	0797	0806	56	1	2	2	3	4	5	6	6	7
34	0.0814	0823	0831	0840	0849	0857	55	35	0.0866	0875	0884	0893	0902	0911	54	1	2	3	3	4	5	6	7	8
36	0.0920	0930	0939	0948	0958	0967	53	37	0.0976	0986	0996	1005	1015	1025	52	1	2	3	4	5	6	7	8	9
38	0.1035	1045	1054	1065	1075	1085	51	39	0.1095	1105	1116	1126	1136	1147	50	1	2	3	4	5	6	7	8	9
40	0.1157	1168	1179	1189	1200	1211	49	41	0.1222	1233	1244	1255	1267	1278	48	1	2	3	4	5	7	8	9	10
42	0.1289	1301	1312	1324	1335	1347	47	43	0.1359	1370	1382	1394	1406	1418	46	1	2	4	5	6	7	8	9	11
44	0.1431	1443	1455	1468	1480	1493	45	45	0.1505	1518	1531	1543	1556	1569	44	1	2	4	5	6	7	9	10	11
46	0.1582	1595	1609	1622	1635	1649	43	47	0.1662	1676	1689	1703	1717	1731	42	1	3	4	5	7	8	9	11	12
48	0.1745	1759	1773	1787	1802	1816	41	49	0.1831	1845	1860	1875	1889	1904	40	2	3	5	6	7	9	10	12	13
50	0.1919	1934	1950	1965	1980	1996	39	51	0.2011	2027	2043	2058	2074	2090	38	2	3	5	6	8	9	11	12	14
52	0.2107	2123	2139	2155	2172	2189	37	53	0.2205	2222	2239	2256	2273	2290	36	2	3	5	7	8	10	12	13	15
54	0.2308	2325	2343	2360	2378	2396	35	55	0.2414	2432	2450	2469	2487	2506	34	2	4	5	7	9	11	13	14	16
56	0.2524	2543	2562	2581	2600	2619	33	57	0.2639	2658	2678	2698	2718	2738	32	2	4	6	8	10	12	14	16	18
58	0.2758	2778	2799	2819	2840	2861	31	59	0.2882	2903	2924	2945	2967	2988	30	2	4	6	8	10	12	15	17	19
60	0.3010	3032	3054	3077	3099	3122	29	61	0.3144	3167	3190	3213	3237	3260	28	2	5	7	9	11	14	16	18	20
62	0.3284	3308	3332	3356	3380	3405	27	63	0.3429	3454	3479	3505	3530	3556	26	2	5	7	9	12	15	17	20	22
64	0.3582	3608	3634	3660	3687	3714	25	65	0.3741	3768	3795	3823	3851	3879	24	3	5	8	11	13	16	19	22	24
66	0.3907	3935	3964	3993	4022	4052	23	67	0.4081	4111	4141	4172	4202	4233	22	3	6	9	12	15	18	21	24	27
68	0.4264	4296	4327	4359	4392	4424	21	69	0.4457	4490	4523	4557	4591	4625	20	3	7	10	13	17	20	24	26	30
70	0.4660	4694	4730	4765	4801	4837	19	71	0.4874	4910	4948	4985	5023	5062	18	4	7	11	14	18	22	25	29	33
72	0.5100	5139	5179	5219	5259	5300	17	73	0.5341	5382	5424	5467	5510	5553	16	4	8	12	16	21	25	29	33	37
74	0.5597	5641	5686	5731	5777	5823	15	75	0.5870	5918	5965	6014	6063	6113	14	5	9	14	19	24	28	33	38	42
76	0.6163	6214	6266	6318	6371	6425	13	77	0.6479	6534	6590	6647	6704	6762	12	5	11	16	22	27	32	38	43	49
	60′	50′	40′	30′	20′	10′	Cosec		60′	50′	40′	30′	20′	10′	Cosec	1′	2′	3′	4′	5′	6′	7′	8′	9′
	Minutes for Log Cosecants.								Enter at bottom for Cosecants							Diffs. for minutes—Subtract								

To Find the Hour Angle on the Prime Vertical

Enter Plate I with the latitude on the top or bottom margin; the intersection of the vertical line through this point with the curve corresponding to the declination of the body fixes a horizontal line which determines the hour angle of the body on the left hand margin.

The "Time Sight or Chronometer" Problem

Fig. 4 shows Rule II designed to find the hour angle of the observed body, given the latitude, declination and true altitude of the body.

Fig. 5 shows the arrangement of the scales.

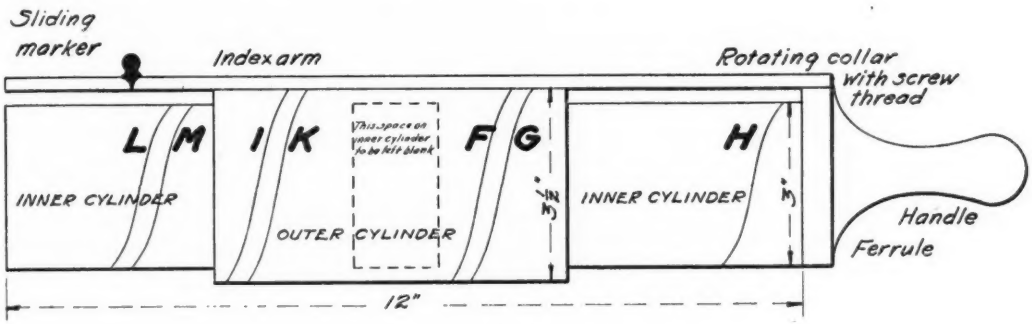


Fig. 4

Description of Scales *I*, *K*, *L* and *M*

I is a scale of log sines with the corresponding degrees and minutes.

K is a scale of log haversines with the corresponding hours and minutes.

L is a scale of log secants with the corresponding degrees and minutes.

M is a decimal scale of natural numbers on which (log sec L+log sec d) may be found.

Formula (3) $$\frac{\text{hav } t}{\sec L \sec d} = \frac{\sin (s-h)}{\sec s}$$

in which $s=\frac{1}{2}(L+h+p)$ and $p=90^\circ \pm d$, the other quantities being the same as before.

To Compute the Hour Angle

Set the left edge of the index arm to $s=1/2\ (L+h+p)$ on scale L, inner cylinder; turn outer cylinder and set index arm to $(s-h)$ scale I, outer cylinder; move sliding marker to this point, then rotate collar until index arm, left edge, coincides with (log sec L+log sec d) from Table I, on scale M, inner cylinder, and the sliding marker will show the point on scale I opposite which on scale K will be found the hour angle.

The azimuth is found as with Rule I.

To Find the Great Circle Distance—Rule I

Given the latitudes, L_1 and L_2, of A and B, the points of departure and destination and the difference of longitude, λ, between their meridians, find the great circle distance, D, between A and B.

Formula (4) $\dfrac{\text{hav } \alpha}{\cos L_2} = \dfrac{\text{hav } \lambda}{\sec L_1}$, in which α is an auxiliary angle.

1. Set the index arm to L_1 on scale E.
2. Turn the outer cylinder and set the index arm to the difference of longitude, λ, on scale A; set marker.
3. Rotate collar and set index arm to L_2 on scale D; the marker will indicate on scale A the point opposite which on scale B will be found hav α.
4. From scale B take hav $(L_1 \sim L_2)$; add this to hav α for hav D and opposite this number on scale B will be found D on scale C.

TO FIND THE GREAT CIRCLE COURSE

Formula (5) $\frac{\sin C_1}{\sec (90°\sim D)} = \frac{\sin \lambda}{\sec L_2}$, in which C_1 is the initial great circle course.

1. Set the index arm to L_2 on scale H.

2. Turn the outer cylinder and set the index arm to the difference of longitude, λ, on scale F or G, and set marker.

3. Revolve collar and set index arm to $(90°\sim D)$ on scale H and the marker will show the great circle course on scale G.

Rule I may be also used to find the hour angle, t, and declination, d, of an unknown star, given the latitude of the observer, L, the true altitude of the star, h, and its azimuth, Z, reckoned from the elevated pole.

The "altitude azimuth" may be solved with Rule II.—Given the latitude of the observer, the true altitude and declination of the body, to find its azimuth.

Set the left edge of the index arm to $s=1/2(L+z\pm d)$ on scale L, inner cylinder; turn outer cylinder and set index arm to $(s\mp d)$ on scale I, outer cylinder; move sliding marker to this point, rotate collar until left edge of index arm coincides with (log sec L+log sec h), from Table I, on scale M, inner cylinder, then the marker will show the point on scale I opposite which on scale K will be found the azimuth in hours and minutes; convert to degrees.

(1) The upper signs in the above expressions are used when L and d are of the same name and the lower when of contrary names.

(2) The azimuth is given the same name as the latitude and is marked East or West like the hour angle.

(3) When this method is used it is not necessary to have recourse to Plate I, the azimuth being always reckoned from the elevated pole.

Rule II may be used also to find the initial and final great circle courses when the great circle distance between two places is known.

Given the latitudes, L_1 and L_2, of the points of departure and destination with the *G. C. D.*, D, between them, find the initial and final *G. C.* courses, C_1, and C_2.

(4) To find the initial course. Set the index arm to $s=1/2(L_1+D\pm L_2)$ on scale L, turn the outer cylinder and set index arm to $(s\mp L_2)$ on scale I, set marker at this point, rotate collar and set index arm to (log L+log cosec D) from Table I, on scale M and the marker will show the point on scale I opposite which on scale K will be found C_1 in hours and minutes; convert to degrees.

(5) To find the final course. Proceed as above using $s=1/2(L_2+D\pm L_1)$ on scale L and $(s\mp L_1)$ on scale I with (log sec L+log cosec D) on scale M.

(6) In the above expressions use the upper signs when L_1 and L_2 have the same name and the lower signs when they have contrary names.

(7) Give C_1 and C_2 the names of L_1 and L_2, respectively; C_2 is thus reckoned as an initial course; reverse its direction for the final course.

(8) The G. C. D. may be found from time to time by deducting the distance made good from the port of departure from the original distance.

Scales F, G and H may be omitted from Rule II, Fig. 4, and with the four scales L,M, I and K the following problems may be solved:

(a) The Time Sight.
(b) The Altitude-Azimuth.
(c) Finding the great circle course.

With (a) and (b) a Sumner Line may be obtained by the tangent method.

With Rule I and a minimum of six scales the following problems may be solved:

(d) Computing the zenith distance.
(e) Time-Altitude Azimuth.
(f) Finding the great circle distance.
(g) Finding the great circle course.
(h) Indentifying an unknown star by its altitude and azimuth.

With (d) and (e) a line of position may be obtained by the Marcq Saint-Hilaire method.

It appears that there is not so much difficulty in providing the means for the aviator to solve the astronomical triangle quickly as there is in measuring the altitude of a heavenly body accurately from an airship; to obtain the correct altitude is the real problem.

Characteristics *and* Uses *of* Aluminum Alloys

By Lieutenant Commander Homer N. Wallin *(CC), U. S. Navy*
and
Mr. Floyd B. Olcott, *Materials Engineer, Bureau C. & R., Navy Dept.*

Its Increasing Importance

I. THE increasing importance of aluminum and aluminum alloys as materials of construction makes desirable the promulgation of certain information in regard to general use, installation, and preservation of these relatively new materials. Aluminum and aluminum alloys for ship use have long been regarded with skepticism, largely due to improper uses, no doubt. Recent improvement in quality and a broader knowledge of application have permitted designers to accept the known limitations of aluminum* in order to take advantage of its special merit, namely, maximum strength for minimum weight. In commercial fields aluminum alloys are finding wider and wider applications; large quantities are used for automotive work, chemical equipment, aviation, textile machinery, radio, foil, collapsible tubes, conductor cable, etc. At least one railroad has built and is operating a train of coaches in which practically all the structure above the trucks is made of aluminum. Street car companies are employing aluminum alloys for practically all car parts except the wheels and axles. Aluminum furniture is being extensively developed. A 3,800-pound cored casting has recently been poured for a Diesel engine foundation aboard a yacht. Aluminum paint is being widely used, even as a priming coat for steel. The uses for aluminum will be discussed in this paper as applied primarily to naval vessels and will not cover the specialized uses in the field of aëronautics.

* The term "aluminum" is used in this paper generically and refers to either the commercially pure aluminum or to the several aluminum alloys.

2. On naval vessels aluminum has heretofore been used but little because of definite limitations of this metal with respect to its physical properties as compared to those of the metals commonly used in ship construction. The Treaty for Limitation of Naval Armaments has, however, given an impetus to the study of the utilization of aluminum on shipboard. As a result, aluminum alloys have been authorized for certain shipboard uses by the various technical bureaus of the Navy Department. Such uses of aluminum are restricted to those in which a failure of the material would not endanger the safety of the ship or cause injury to personnel. Additional uses will of course follow if the service installations already authorized are sufficiently satisfactory. Satisfactory usage of aluminum will depend to a large extent upon the care and preservation accorded by the forces afloat.

Limitations

3. In addition to its disadvantage of limited strength, aluminum has always been regarded as highly susceptible to salt water corrosion. In the case of the older aluminum alloys especially, salt water usually caused rapid deterioration and practically precluded their use on naval vessels. As a result of intensive metallurgical research, however, there has recently been great improvement in the properties of aluminum. These improvements have not entirely removed the former weaknesses, but have brought about an understanding of the properties of aluminum such that its limitations and restrictions can be fairly well met. One of the noteworthy limitations in the physical properties of aluminum, often overlooked, is the fact that the modulus of elasticity is

about 10,000,000 as against 30,000,000 for steel. Because of this fact an aluminum beam, for example, would suffer about three times as much displacement in bending as would a similar steel beam subjected to the same load. This modulus is constant for all aluminum alloys and must be compensated for in design and application. Great effort is being made by engineers to develop designs which will permit a weight saving of about sixty per cent by substituting aluminum for steel and yet give the same factors of safety as the original steel design. This is often accomplished, in spite of the low modulus of elasticity, by efficient distribution of cross sectional areas and by suitable bracing. Though aluminum is being extensively used in very important commercial applications it cannot be used safely in naval design where the structural or watertight integrity of the ship might be affected. Further improvements in aluminum will of course eliminate some of the present necessary restrictions as to its use.

General Physical Properties

4. For ready reference some of the physical properties of aluminum are noted:

Specific gravity—2.65 to 2.90.

Approximate weight per cubic inch—0.10 pounds.

Modulus of elasticity—10,000,000 pounds per square inch.

Melting point—approximately 1220° F.

Shrinkage allowance for pattern making—0.156 inch (5/32 inch) per foot.

Ratio of Weights of Equal Volumes

Commercial aluminum	1.00
Zinc	2.63
Cast iron	2.63
Tin	2.70
Soft steel	2.89
Cast brass (Cu 70-Zn 30)	3.12
Cast bronze (Cu 90-Sn 10)	3.26
Nickel	3.26
Copper	3.30
Lead	4.18

Forms Commercially Available

5. Aluminum is furnished in cast, rolled, forged, drawn, or extruded form as required. Pure aluminum must be alloyed with other elements such as copper, manganese, silicon, magnesium, etc., to provide satisfactory physical properties. These alloys are commonly referred to as aluminum-manganese, aluminum-silicon, "Duralumin," etc. Navy Department leaflet specifications covering the alloys considered most desirable for Navy use have been prepared. In Navy specifications the trade mark or copyrighted names are not used. For instance the alloy marketed by the Bausch Machine Tool Company under the name "Duralumin" and by the Aluminum Company of America as "No. 17S" is described in the Navy leaflet specifications 47A3 as "Aluminum Alloy, Sheet (Aluminum-copper-magnesium-manganese)." For the sake of brevity the commonly known term "Duralumin" is used in this paper when referring to this alloy.

6. For the benefit of repair and foundry personnel on shipboard and elsewhere the uses and effects of the various alloying elements are outlined below:

Copper.—Copper is the most commonly used hardener and is present to some extent in the majority of the prominent casting alloys. The most widely used casting alloy in this country is that used in the automotive industry and generally known as "No. 12," or "S.A.E. No. 30." This alloy contains about eight per cent copper. It is not suitable for naval work on account of its notable lack of resistance to salt water corrosion and its low ductility. The elongation in two inches is from one per cent to two per cent.

Zinc.—Zinc has been used as a hardener for aluminum to a greater extent in Europe than in this country. Zinc is cheaper than copper and when properly used the castings conform sharply to the patterns and are sound and clean. There are numerous difficulties, however, in the casting of the aluminum-zinc alloys due to the volatility of the zinc. These alloys are heavier than many of the other aluminum alloys and lose their strength rapidly with increased temperatures.

Manganese.—Manganese when added in small percentages increases the physical properties and the corrosion resistance of aluminum. Castings containing manganese are more or less difficult to make owing to the high solidification shrinkage. An example of the successful use of manganese is Class 1 alloy in Navy Department leaflet specifications 46A1. This alloy was developed by the naval gun factory.

Silicon.—Silicon as an alloying element with aluminum is one of the newer developments which has come to the front rapidly

in the last two years. Silicon greatly increases the fluidity of aluminum and enables the casting of intricate shapes and thin sections contiguous to heavy sections. The extremely low solidification shrinkage of the silicon alloys increases the ease of casting. The use of silicon produces an aluminum alloy with maximum resistance to salt water corrosion which makes it of particular value for naval work. Class 2 alloy in Navy Department leaflet specifications 46A1 is probably the most reliable and useful of the silicon alloys.

Iron, Magnesium, and Nickel.—Iron is nearly always present in aluminum as an impurity. Magnesium and nickel are used to a less extent with aluminum than the previously mentioned elements. An alloy of considerable prominence in England and frequently referred to in technical literature is Rosenhain's "Y" alloy. This alloy contains about four per cent copper, two per cent nickel and one and one-half per cent magnesium, and is a good example of the nickel-magnesium series. Castings of this alloy are susceptible to heat treatment and develop high tensile strength but have low ductility. One of the advantages of this alloy is its ability to retain its strength at high temperatures. "Y" alloy is used but little in this country owing to the development of heat treated casting alloys in American foundries which are better suited for general uses.

Navy Casting Alloys

7. The bureaus of the Navy Department have a record of some seventy casting alloys, together with their chemical characteristics and physical properties. Of the available alloys three were selected for inclusion in Navy Department leaflet specifications 46A1 as being best suited for naval work. Strength, ductility, shock resistance, and resistance to salt water corrosion were the main considerations in this selection. Foundry personnel are reminded that satisfactory physical properties cannot result from mongrel alloys; the chemical requirements of the specifications should be rigidly adhered to. The chemical and physical properties of the three Navy alloys are outlined in Table 1.

Class No. 1.—This alloy has been developed by the naval gun factory and is seldom used by commercial foundries, largely because of the high shrinkage. The naval gun factory, however, obtains uniformly consistent results with this alloy. It has the highest degree of resistance of the four alloys to impact as shown by Izod tests, and is the most ductile.

Class No. 2.—This alloy is commonly termed the five per cent silicon alloy. It is the easiest of the four alloys to cast, its fluidity being due to the silicon content. It has low shrinkage and is adaptable to castings of thin section or intricate design. It has a dense structure making it suitable for work under moderate pressure and is one of the best alloys as regards resistance to salt water corrosion. Class 2 alloy is regularly produced by several of the navy yards and is readily obtainable from many commercial foundries. No heat treatment or special process is involved in its production.

Class No. 4.—Castings of this alloy require heat treatment to develop the required physical properties. This is the strongest, stiffest, and hardest of the four alloys and has good resistance to impact as shown by Izod tests. Of the four alloys, Class No. 4 has the greatest resistance to deformation by suddenly applied loads. It is not believed to be as resistant to salt water corrosion as the other alloys. This alloy is not particularly difficult to cast nor is its heat treatment involved.

Table 1.

Class	Chemical Requirements							Physical Requirements	
	Al Min.	Cu Max.	Si Max.	Zn Max.	Fe Max.	Mg Max.	Mn Max.	Min. Tensile lbs. per sq. in.	Min. Elong. in 2 in.
No. 1....	96.5	1–1.5	0.50		0.7		0.7–1.2	19,000	10.0
No. 2....	92.5	0.6	4.5 –6.0	0.20	1.0		0.2	17,000	3.0
No. 4....	94.5	4.5	1.20	0.25	1.20	0.35		28,000	6.0

No. 4 is a heat treated alloy.

TABLE 2.

Class	Resistance to Corrosion	Stiffness	Hardness	Shock Resistance Izod Values	Ease of Casting	Machinability	Proportional Limit lbs. per sq. in.	Brinell Hardness Number
No. 1....	1	2	2	1	3	2	3500	40
No. 2....	1	3	3	3	1	3	3000	40
No. 4....	2	1	1	2	2	1	12000	70

Previously an alloy (No. 3) known as the thirteen per cent silicon was included in Navy specifications but has been eliminated due to difficulty in procuring consistent properties, particularly elongation.

8. Table 2 lists the approximate comparative characteristics of the three alloys. Research to date has not been extensive enough to establish definitely some of the factors listed. Comparative resistance to corrosion, in particular, has not been definitely established. This table, however, represents the best knowledge at present available and may serve as an aid to designers and users.

ROLLED, DRAWN OR EXTRUDED ALLOYS

9. Of the many commercial alloys available in the above forms, the Navy has standardized on three: "Duralumin," aluminum-manganese, and commercially pure aluminum.

10. *"Duralumin."*—This alloy is the strongest and probably the most prominent of the rolled alloys. It is marketed by the Bausch Machine Tool Company under that trade name. The Aluminum Company of America markets this alloy under the trade name of "No. 17S." Navy Department leaflet specifications described this alloy as "Aluminum Alloy (Aluminum-copper-magnesium-manganese)." The following leaflet specifications have been prepared for this metal.

For sheets 47A3
For rods, bars and shapes 46A4
For seamless tubes 44A2

The chemical composition of this alloy is as follows:

Copper ..... 3.5% to 4.5%
Magnesium ..... 0.2% to 0.75%
Manganese ..... 0.4% to 1.0%
Aluminum ..... 92.0% Min.

This alloy must be heat treated to obtain the maximum strength. The physical properties vary according to the cross section and shape of the material.

"Duralumin" sheets show a range in physical properties (depending upon the thickness) approximately as follows:

Tensile strength—50,000 to 65,000 lbs. per sq. in.
Yield point—25,000 to 38,000 lbs. per sq. in.
Elongation in 2 inches—25% to 12%.

In the annealed condition the strength is cut down about one-half and the structural value of the material is seriously reduced as well as is its resistance to corrosion.

For "Duralumin" shapes the following minimum requirements are specified:

Tensile strength—50,000 lbs. per sq. in.
Yield point—25,000 lbs. per sq. in.
Elongation in 2 inches—16%.

The physical properties of heat treated rods and bars vary with the cross section. The following are the approximate ranges:

Tensile strength—45,000 to 60,000 lbs. per sq. in.
Yield point—20,000 to 33,000 lbs. per sq. in.
Elongation in 2 inches—25% to 12%.

"Duralumin" should never be welded where strength is an important factor. If welding is resorted to, however, the complete part must be heat treated subsequent to welding. Drop forgings having the strength of mild steel may be satisfactorily made from this alloy.

11. *Aluminum-Manganese Alloy.*—The aluminum-manganese alloy has come rapidly to the front in the past year as being one of the most useful of the rolled alloys for purposes where the higher strength of "Duralumin" is not required. The aluminum-manganese alloy is more resistant to salt water corrosion and is considerably cheaper than "Duralumin." It may be rolled in various tempers from soft to hard as desired, the rigidity, hardness and tensile strength increasing as the temper or amount of cold working, is increased. The chemical composition is as follows:

Manganese ..... 1.0% to 1.5%
Copper ..... 0.2% Max.
Aluminum ..... 97.0% Min.

The range of physical properties depending on temper and thickness of sheet is as follows:

Min. tensile strength—16,000 to 33,000 lbs. per sq. in.
Min. elongation in 2 inches—25% to 1%.

Sheets of this alloy are described in Navy Department leaflet specifications 47A4. Pipe, tubing, rods, bars and rivets are also produced from this alloy.

This alloy has superseded "Duralumin" as a material for motor boat canopies, largely on account of its superior workability, lower price, rigidity in the temper used (¾ hard), and availability in larger sizes. This alloy is marketed by the Aluminum Company of America under the trade name "3S" and is not proprietary.

12. *Commercially Pure Aluminum.*—Commercially pure aluminum (ninety-nine per cent al.) is furnished in rolled, extruded or drawn forms and is described in the following Navy Department leaflet specifications:

For sheet	47A2
For rods, bars and shapes	46A3
For tubes	44A1

This material is no cheaper than the aluminum-manganese alloy and has considerably lower physical properties. It is softer and easier to deep draw, spin and weld than the aluminum-manganese alloy and is largely used for the manufacture of utensils, tanks and fabricated articles where especial strength is not required.

Application

13. In the paragraphs immediately following are listed some of the general shipboard applications of aluminum alloys which may be considered as typical.

Casting Alloys.—

Class 1.—Electrical equipment for fire control system, junction boxes, etc.

Class 2.—Watertight covers for ventilation systems; airport frames and lens frames for airports well above the waterline; cast portions of guards for gears; base castings for individual waterclosets; brackets for standing lights; metal hose racks; bedplates for motors and pumps; furniture fittings, etc.

Class 4.—Blast covers for airports, fittings for ammunition hoists, ladder treads for companion ladders, bed plates, hand wheels, etc.

Duralumin.—For minor structural purposes as shapes for stowage, airplanes, rigid airships, furniture frames, cabinets, file cases, shelving, bins, etc.

Aluminum-Manganese Alloy.—For motor boat canopies, divisional bulkheads, joiner doors,cabinets, file cases, shelving, bins, etc.

Commercially Pure Aluminum.—This material has very little application for structural purposes, but is used to some extent in the manufacture of cooking and other utensils.

Installation

14. The determination of proper methods of installation and preservation of aluminum alloys has been the aim of thousands of tests and experiments. Corrosion has been the bugaboo of aluminum on board ship, and very careful steps must be taken at the time of assembly and thereafter to prevent corrosion. While some test results have been differently interpreted by interested engineers, the broad results have been in general agreement regarding the corrodibility of aluminum. As regards method of installation on shipboard, there are three important conclusions or cautions:

(a) Do not install aluminum where it will be in continuous contact with salt water or salt spray.

(b) Do not install aluminum in metal-to-metal contact with copper alloys; suitable insulating materials should be used.

(c) Do not install aluminum adjacent to wood which may be damp most of the time from the intermittent presence of sea water.

15. The fabrication and assembly of aluminum is not especially difficult. Due to its greater ductility aluminum is more easily worked than steel, but also more easily abraded and abused. Tools for working aluminum should be very sharp and highly polished. Cutting tools should have considerable side and top rake and should be used with soluble oil cutting compounds.

16. *Working Fits.*—In fitting working parts, considerable looseness in fit must be provided to prevent seizing. This is particularly true of aluminum against aluminum. Contact surfaces of working parts should be periodically oiled or greased. Where a threaded connection is used between two parts of aluminum a suitable "anti-seize" compound should be used, such as a mixture of zinc dust and vaseline or an

emulsified asphalt. Rust preventive compounds should be satisfactory. Tight fitting threads in aluminum may cause "freezing"; "shakey" fits are essential. Brass threads should never be used in contact with aluminum. Brass pins should never be used with aluminum hinges. Steel pins are best, preferably of corrosion resisting steel.

17. *Riveting and Bolting.*—Fittings may be secured by steel bolts, screws, or rivets. Aluminum alloy rivets ("Duralumin" or aluminum-manganese alloy depending on the service) may be used in sizes up to and including one-half inch diameter. "Duralumin" has approximately twice the strength of the aluminum-manganese alloy, and rivets made of this alloy should be heat treated before using and driven cold as soon as possible (within one hour) after heat treating. On aluminum rivets a compression riveter should be used where practicable. Aluminum rivets should be driven with a few heavy blows rather than by numerous light blows.

18. *Welding.*—Autogenous gas welding is, in general, satisfactory for welding aluminum to aluminum. Due to its lower temperature the hydrogen flame is more suitable than the acetylene flame for most work. The average efficiency of a weld properly made in commercially pure aluminum or in the aluminum-manganese alloy is (on a percentage basis) comparable to a similar weld in steel. In the high strength alloys, however, the elongation and tensile strength of the material (cast) in the weld are low and therefore the ductility and strength of such a weld are not comparable in efficiency to a similar weld in steel. "Duralumin" should never be welded where strength is important, but when it is welded the complete part must be heat treated subsequent to welding. It should be especially noted that aluminum fittings cannot be satisfactorily welded to steel. Soldering is practicable under certain conditions, but is not very satisfactory. In welding it is important that the proper technique be used by personnel trained in aluminum welding. A suitable flux must be used. In order to prevent alkaline corrosion great care must be taken to scrub off all traces of the flux with hot water. A better method is to dip in a hot two per cent solution of nitric acid, followed by a hot water rinse. This is most essential as such fluxes contain chlorides and fluorides which will absorb moisture from the atmosphere and cause rapid corrosion of the metal even though painted. Welding should not be done on board ship where the opposite side of the material is inaccessible for the removal of the flux.

19. Electric spot welding is entirely satisfactory and is in general use except for parts subjected to vibrational stresses. The welded spot consists of metal in the cast state and therefore has low ductility. The copper electrodes of the welding machine tend to become fouled with oxides, but this is obviated if the tips of the electrodes are chromium plated.

20. Experience is the best teacher, and is essential for satisfactory fabrication and installation. The points mentioned above are only the high lights; complete information on any of the operations such as casting, heat treating, or machining is readily procurable from the leading manufacturers of aluminum.

PRESERVATION

21. The chief danger in the use of aluminum in the Navy lies in its susceptibility to corrosion. Though aluminum in the open air may be somewhat less corrodible than steel, yet corrosion of aluminum is of an insidious nature. When corrosion once begins it is as fatal as galloping consumption unless arrested in the early stages. The first stages of corrosion are difficult to detect, at least for the unpracticed eye. The small gray powder deposits which first appear, quite soon under certain conditions grow into sizable flakes and later into general disintegration of the metal. In the case of "Duralumin" at least, "intercrystalline corrosion" seems to occur with disastrous effects on the physical properties, especially the elongation. This internal corrosion is not always readily observable on the surface.

22. In order for the Navy to benefit from the weight saving permitted by the use of aluminum, the chief effort to insure satisfactory utilization must be centered on preservation. Many preservatives have been tested and some have been found fairly good; however, all have a limited life thus necessitating periodic refinishing. Suitable protection against corrosion therefore depends upon continual vigilance to detect corrosion and to arrest it. Repainting of aluminum is handled along the same lines as is the repainting of steel.

23. All surfaces of aluminum should be painted with several coats of approved preservative such as aluminum varnish or bituminous varnish. This should be done as soon after fabrication as practicable.

24. It is good practice to apply one coat of preservative prior to assembly, especially so if the parts are to remain in storage very long. Faying surfaces should be painted during assembly. A satisfactory formula for the manufacture of aluminum varnish is as follows:

Aluminum powder	100 lbs.
Water resisting spar varnish ...	50 gals.

The naval aircraft factory has developed a formula for satisfactory bituminous varnish which is as follows:

Aluminum powder	100 lbs.
Bituminous primer	50 gals.

This formula is used for airplane hulls or other parts exposed to salt water or salt spray.

25. Although the above named varnishes appear most satisfactory as priming coats, ordinary red lead is permissible. The theory that lead paints might cause local corrosion due to galvanic action between the aluminum and the paint ingredients has been fairly well disproved. Where it is necessary to make the color of the paint applied to the aluminum conform to the color of the surrounding paintwork, standard oil paints should be applied over either one or two coats of aluminum varnish.

26. In case aluminum is necessarily installed in contact with a dissimilar metal, the faying surfaces must be properly insulated from each other by the use of bituminous solution or bituminous varnish. Tarred felt is good but should not be used where it might soak up water.

27. Before applying any kind of paint to aluminum, it is essential that the surfaces be properly prepared. Castings should be sand blasted, rumbled, or wire brushed. Wrought material should first be thoroughly cleaned of any oil by a solvent such as gasoline, benzine or carbon tetrachloride. Then the material should be sand blasted or wire brushed in order to roughen the surface sufficiently to permit adhesion of the paint. When conditions permit, more thorough methods such as a caustic dip followed by a hot water rinse, and then by a dip in hot concentrated nitric acid and final water rinse, should be used in lieu of the above. Some alloys of aluminum are delivered with a fairly rough surface known as "gray finish." For such materials sand blasting or wire brushing is not generally necessary. Before painting over welds, extreme care must be taken to completely remove all trace of the welding flux by thorough scrubbing with hot water. A better way is by dipping in a hot two per cent nitric acid solution followed by a hot water rinse. After thorough cleansing a priming coat of paint should be applied without delay.

28. *Contact with Copper.*—In fabricating and installing any parts made of aluminum, it is essential that care be used to avoid intimate contact between aluminum metals electro-positive to aluminum such as copper, brass or bronze, monel metal, etc. Such contact causes severe electrolytic action resulting in the rapid corrosion of the aluminum. When contact between aluminum and brass or bronze is unavoidable, the faying surfaces should be coated with marine glue or bituminous solution. Where practicable, bushings or spacers of corrosion resisting steel are recommended.

29. *Contact with Steel.*—Electrolytic action between aluminum and steel is not severe; especially when the steel is galvanized. Where aluminum is secured to steel the adjacent surfaces should be coated with marine glue or bituminous varnish before assembly. Where steel bolts, black or galvanized, are used in conjunction with aluminum, both the bolt holes and bolts should be painted prior to assembly. The most efficient method is to coat the bolt holes and bolts with sufficient bitumastic or red lead putty to fill all crevices when the bolts are tightened. In all cases, openings or crevices should be avoided as these collect moisture and provide a starting point for attack by corrosion.

30. *Contact with Wood.*—Damp wood in contact with aluminum is almost certain to cause corrosion. When aluminum is installed in contact with wood, a generous quantity of marine glue or bitumastic should be applied to faying surfaces before assembly. Unless this is done the aluminum will corrode badly under salt water exposure, as exemplified in the past by canopy hood installations.

31. Preservation of aluminum by the anodic process should be mentioned. This consists of anodic oxidation of the aluminum in an electrolyte of three per cent aque-

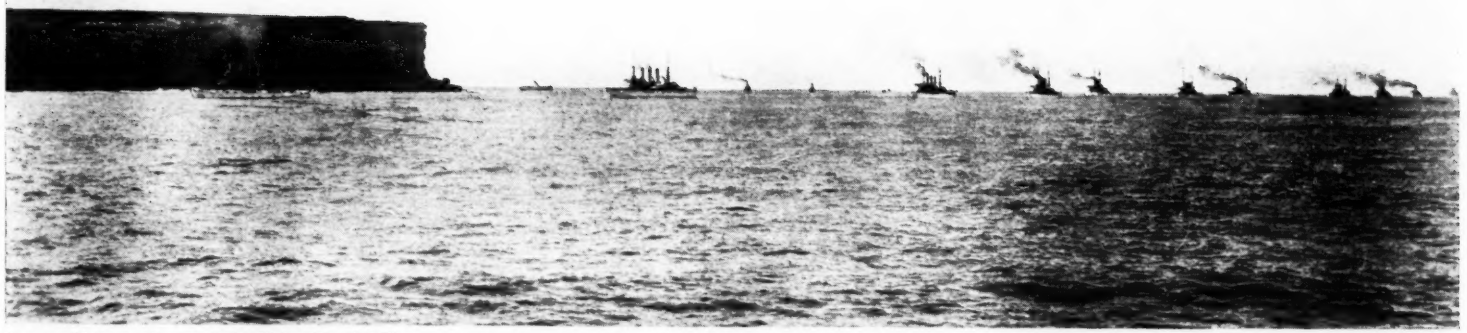
ous solution of chromic acid. Anodic oxidation furnishes an excellent surface for painting or for other coatings to resist corrosion; lanolin is sometimes used. The anodic process with the necessary appropriate coatings is used extensively in England especially for airplane parts. While this means of protection might be satisfactory in the case of small parts it is entirely too expensive for general use.

32. A very important development in corrosion resistance of "Duralumin" has recently been made by the Aluminum Company of America. By a secret process they are able to clad "Duralumin" products with a thin but homogeneous surface of pure aluminum, the latter being very resistant to corrosion. The name of this product is "Alclad."

CONCLUSION

33. The improvements made in the production of aluminum and the Navy's use of the newer alloys are of such recent development that there is yet much to be learned on the subject. The information contained in this paper is perhaps the best available in concentrated form at the present time. It is realized that this paper is somewhat too technical to be interesting reading matter for the average person. The primary purpose is to invite attention to the difficulties which must be met to permit important weight saving on naval vessels through the use of aluminum. The precautions outlined herein are essential to the use of aluminum and must be followed closely to obtain reasonably satisfactory results. It is expected that some failures will be noted in service. Such failures should be studied and steps taken to prevent repetitions. The information gained from the installations now authorized will control the extension of the use of aluminum for more important work.

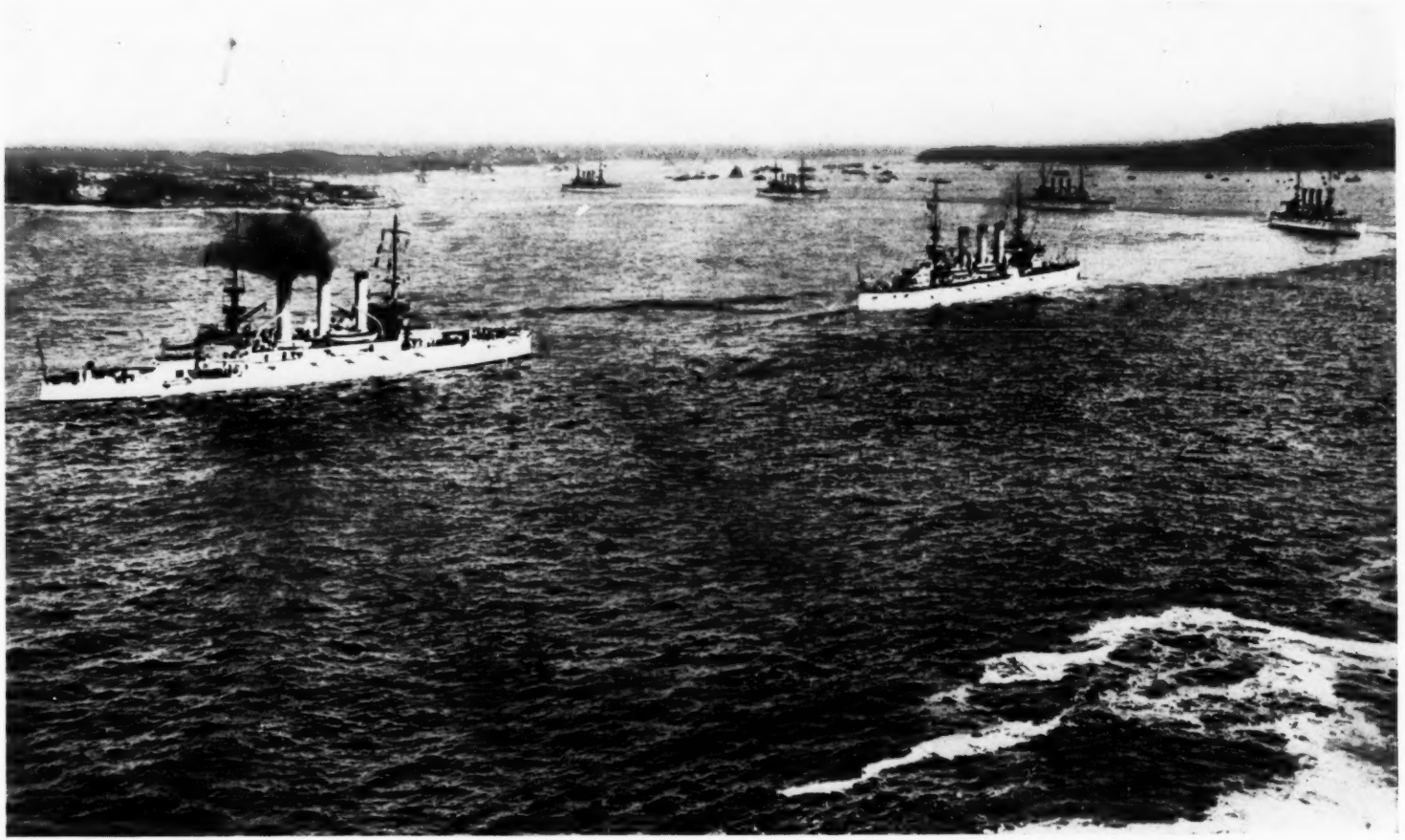
34. The writers are indebted to the representatives of the aluminum industry, particularly the Aluminum Company of America, for much of the information contained herein, and have freely drawn from their papers and discussions.



Courtesy Lieutenant Commander R. Wainwright, U.S. Navy

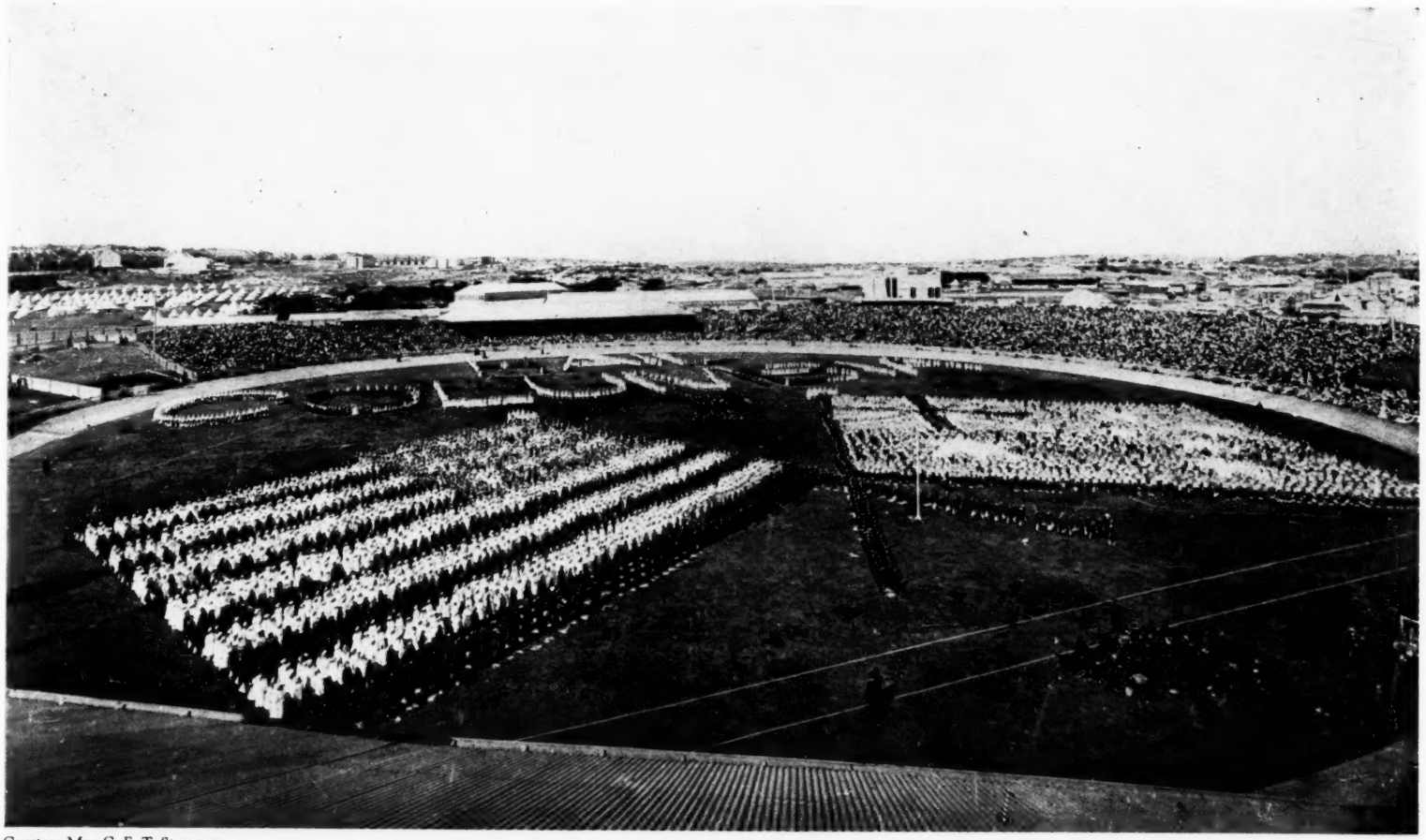
THE FLEET STANDING INTO SYDNEY, NEW SOUTH WALES, AUGUST 20, 1908

Visitors to Sydney are always asked, "How do you like our harbor?" and with a reason, for the answer must always be, "Beautiful." Most people agree that Sydney and Rio de Janeiro have the most beautiful harbors in the world.



Courtesy Mrs. G. E. T. Stevenson

FLEET ENTERING THE INNER HARBOR OF SYDNEY, NEW SOUTH WALES, 1908



Courtesy Mrs. G. E. T. Stevenson

LIVING FLAGS

Reception to the fleet at Sydney race track, 1908. Large numbers of the boys who took part in this pageant were later members of the famous "Anzacs" of the World War.

Navy Recruiting Bureau, New York

GOVERNMENT HOUSE, SYDNEY

Navy Recruiting Bureau, New York

TOWN HALL, SYDNEY
Where a great deal of the official entertaining took place in 1908.

Underwood and Underwood, N.Y.

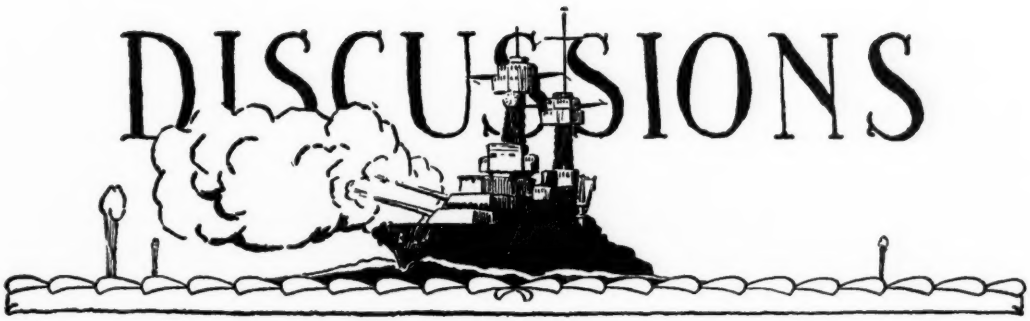
RAILWAY STATION, SYDNEY

Courtesy Mrs. G. E. T. Stevenson

PARADE OF BLUEJACKETS FROM THE FLEET AT SYDNEY, NEW SOUTH WALES, 1908

Courtesy Lieutenant Commander R. Wainwright, U.S. Navy

THE WALLABY MASCOT OF THE U.S.S. *CONNECTICUT*, PRESENTED BY THE CITIZENS OF SYDNEY, NEW SOUTH WALES, 1908



Submarine Sizes

(See page 1292, December, 1927, PROCEEDINGS)

LIEUTENANT COMMANDER W. M. QUIGLEY, *U. S. Navy*.—The subject matter of this article is one which is as old as ships of war themselves. The question of size of various types of naval ships is one which is now under discussion in its application to light cruisers, destroyer leaders, aircraft carriers and other units in the Navy. In no case in design and least of all in submarine construction, is displacement, in a wish to have a ship bigger than any possessed by other navies, decided upon in an arbitrary manner. It is needless to state that in the design of any type of warship certain characteristics are specified, certain requirements are laid down by those responsible for military efficiency, which the constructor must incorporate in the vessel, if such be humanly possible. No one wants large displacement in any type and it is only accepted as the means of getting everything required into the ship.

The author lists various types of submarines built during and subsequent to the late war. As the ninth type he summarizes the characteristics of the *U135-U138* class (1,175 tons surface) and states, "they were considered by the Germans as the last word in medium size submarines and were the result of the best talent in Germany after nearly four years of war experience." It might be inferred from the above that, inasmuch as German designers of submarines were admittedly the best authorities, we should take a "page from their book" and accept the findings of their experience. It is true that we have taken a number of features of material from the German submarines, modified them to our requirements and profited thereby. It is not felt, however, that we may adopt that part of the German submarine policy which applies to displacement without in the same manner modifying and, if necessary, amplifying it to suit our needs. It cannot be assumed that Germany's or any other country's submarine problems will be ours. The distances to be traversed in our "Western Ocean" are considerably greater than in Germany's. Greater feats of performance are to be demanded of our submarines, and the determination of the size of any ship depends upon the duty which that ship is intended to perform. A three-quarter-ton truck can go as fast as a ten-ton truck, but it cannot carry as great a useful load. Vessels built for large performances must be large.

Lieutenant Commander Burrough specifies the ideal submarine: "It would seem that the ideal boat should be of about 1,500 tons surface displacement, eighteen knots speed with a cruising radius of 12,000 miles, four bow, and two stern tubes and one four or five-inch gun. It would be possible to carry at least sixteen torpedoes and possibly more." From knowledge of the requirements of the various activities charged with designing, building and installing the component parts of a submarine, it is not believed that the material necessary to meet these specifications could be crowded into that size of a hull. From past experience these requirements might be met in a boat of 2,200 tons surface displacement.

In this connection, and as an example of the fact that displacement of a vessel depends upon the required performance or the military characteristics demanded of the vessel, it is understood that the later boats of the *Oberon* class (1,480 tons) (British) are of fifteen feet greater length and of 200 tons greater displacement than the *Oberon*. This increase was found necessary in order

to accommodate main engines of higher power, so as to obtain the greater speed demanded of them. If such be the case, it would appear that this class is bordering on the upper limit of the medium size submarines (1,800 tons, surface displacement). Again, size depends upon the use to which the machine is to be put.

To quote the article again, "it is seen that our *V-4*, the largest mine layer in the world, carries sixty mines, while *U-117* carried forty-two." This statement will bear amplification. The *U-117* and her class were designed to carry thirty-four mines in the stowage racks. By stowing two in the mine elevator and three in each tube, a total of forty-two could be carried. It must be understood that under these conditions the six mines stowed in the launching tubes could not be got at for adjustment, inasmuch as there was no room within the boat for such adjustment. In other words these six were carried in what was to all purposes a "wet" stowage. As to their mine carrying capacity, published reports show, however, that the number of mines carried varied according to the amount of other stores (fuel, lubricating oil, spares, food, etc.) carried, and that no more than twenty-eight have been carried, in some instances, due to overweight. It would appear that a fair average would be somewhere between thirty-two and thirty-six.

From articles which have appeared recently on the propriety of a submarine exercising the right of search and seizure upon a merchantman, in time of war, it would appear that the commanding officer of a submarine who committed such an act would go the way of the ill-fated Kidd and of that dour person "Samuel Hall." This fact notwithstanding, it is felt that submarines will exercise the right of any belligerents. The speed of merchant ships as a class is increasing due to competition and to conversion to Diesel engines in so many of this type. Although the speed and surface armament of submarines is not dependent upon the speed and armament of merchant motor ships, the relative balance must be maintained.

It has been stated that the larger submarines are as crowded as the medium or small sized ones. This statement, if correct, is due entirely to the installation of additional equipment which, having been developed recently, is considered essential to the safe operation of the submarine, its battle efficiency or the comfort of the crew, and for which there is insufficient space available in a smaller vessel. However, a glance at the table of "net free air space" in the various classes of our submarines is instructive. Suffice it to say that our larger submarines have many times as much free air space as our smaller boats.

While the V class submarines may not appear to be any roomier than the S class, it cannot be denied that the V class are more habitable. To quote the article: "Even two months of this duty (submarine patrol) would wear the crews down excessively due to the cramped living quarters and the lack of sufficient cold storage and fresh water." The necessary equipment and space to meet the deficiencies on the small and medium sized submarines can be, and are "worked into" the large sized boats. This being the case, and in consideration of our peculiar needs, it is submitted that the larger type is more desirable in that it will permit a fresher crew to exert the greatest weight of effort at the greatest distance.

Test of Fact Against Fiction in the Battle of Jutland

(See page 169, March, 1928, PROCEEDINGS)

COMMANDER C. S. STANWORTH, *U. S. Navy*.—In reading the excellent article on the battle of Jutland in the March issue, I was impressed by the statement that the prestige gained by the successful handling of the German fleet in contact with a superior English fleet was a factor in the adoption by the Germans of unrestricted submarine warfare. Also that the subsequent destruction of merchantmen by submarines brought more peril to the cause of the Allies, destroyed more physical values, than a ninety per cent loss of the English fleet would have, had Admiral Jellicoe pressed home his attack, and won a decisive victory. The injury to England's navy spirit is incalculable.

Admiralty instructions to Admiral Jellicoe were based upon the pernicious doctrine of a "Fleet in Being" and curiously enough the May issue of the PROCEEDINGS publishes an article deprecating the execution of Admiral Byng. Had the English Admiralty adhered to the policy that justified the execution of Admiral Byng, and not lent an attentive ear to the teachings of

Admiral Colomb, the Battle of Jutland would have had a different ending. Admiral Mahan found little to approve of in the policy, "Fleet in Being."

This leads me to the propriety and timeliness of a discussion of navy spirit, and the limitations it places on instructions issued by an admiralty or navy department, here today, gone tomorrow.

L'Esprit Navale

In the days of sailing ships when cordage was all important, ropes woven for the English Navy had a blue strand in the cordage so that navy rope could always be distinguished. So in the history of navies you can detect the blue strand of navy spirit, placed there in early days by some worthy sailor, and more or less unconsciously adopted as the guiding principle of succeeding officers.

In 1588, Sir Richard Grenvil, commanding the *Revenge,* was surprised in a harbor in the Azores by a Spanish fleet of fifteen ships. Instead of surrendering to a superior force, the *Revenge* fought, and though finally captured or sunk, inflicted such damage to the Spanish fleet that it became an English Navy tradition that one English ship could whip five Spanish.

In the fight between the *Bon Homme Richard* and the *Serapis,* John Paul Jones laid his ship alongside the enemy as the *Bon Homme Richard* was sinking, and captured the *Serapis.* "We have not begun to fight," became a slogan for our Navy.

The web that connects cause and effect is too intricate for any commanding officer to say, "My surrender to a superior force will not be important," as is illustrated in the following.

In 1815, Captain S. C. Reid in command of the privateer *General Armstrong* was in the harbor of Funchal, when the English squadron convoying Sir Edwin Pakenham's troops to capture New Orleans appeared in the offing, and sent in a boat expedition to cut out the *General Armstrong.* This and a second boat attack were repelled, and Captain Reid, when his ship was finally disabled by gun fire, took possession of a Portuguese fort, and continued the fight.

The English squadron remained at Funchal for several days to repair the damages inflicted by Reid, and the delay this caused in the arrival of Pakenham's troops enabled General Jackson to organize the defense of New Orleans.

Influenced by the teachings of Admiral Colomb, the English Admiralty has at various times stressed the importance of "Fleet in Being," and there was a dim shadowing of this policy in the instructions given by our Navy Department to Admiral Sampson off Santiago in 1898.

What effect the instructions to Admiral Sampson not to risk his battleships had, is not known, but their purpose had largely disappeared when the *New York* arrived off Santiago, and found the Spanish ships practically destroyed, and the harbor open. Had he signalled, "Follow the flag," and steamed into Santiago harbor and forced a surrender, the gain to navy spirit would have more than offset the loss of several ships, and we would have had no Sampson-Schley controversy.

The Articles of War adopted by act of Congress prescribe such punishment as a court-martial may inflict on any commanding officer who does not do his utmost to bring his ship or ships into action, and both the English and our Navy have court-martialed officers under this article, but there has never been a court-martial of an officer for fighting against odds.

No navy department has the moral right to issue instructions that violate the living navy spirit, and in view of the Articles of War, they would have no legal right.

Every naval officer should be indoctrinated with the thought that he can be court-martialed for using his judgment not to fight, but that if he fights even against overwhelming odds, his defeat will be a victory for true navy spirit.

Boilers

(See pages 235, 236, March, 1928, PROCEEDINGS)

LIEUTENANT CARL J. LAMB, *U.S.N.R.* —In reading the March, 1928, issue of the PROCEEDINGS, I ran across some matter on pages 235-236, under the heading "Professional Notes," "United States," concerning which I think comment is appropriate.

In discussing the *Saratoga* and *Lexington,* it was stated, "It is of interest to note that the boilers in both the *Saratoga* and *Lexington*—the highest-powered ships ever built—are of British design."

As a matter of fact, I believe it is true that practically all of the express type boil-

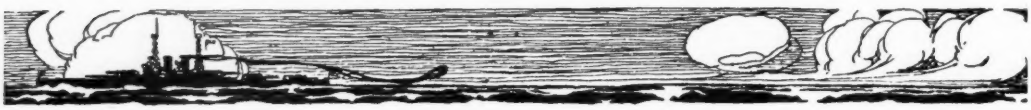
ers (small tube) in U. S. naval vessels of any appreciable size (destroyers and larger) are of British design. Also, the shipyard built geared turbines are of British or other foreign design, and when the Navy builds vessels with such foreign designed machinery in them, it is subsidizing the foreign equipment builders, because of the royalty money sent abroad. Aside from the military importance of keeping the detailed design of such important machinery from reaching other navies, it would seem best to encourage American manufacturers and designers of machinery by using our own designs and to spend relatively large sums of royalty money inside of the United States.

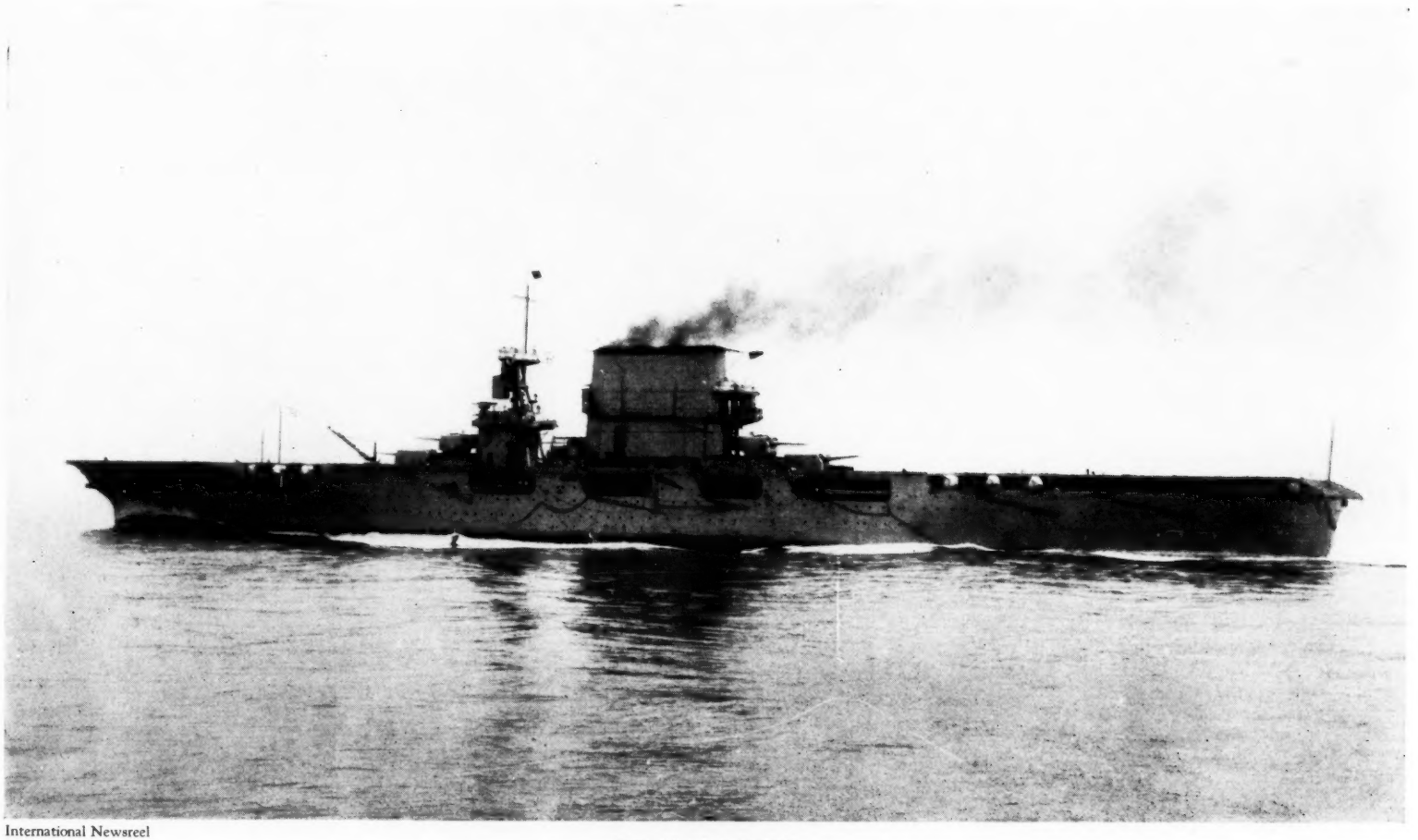
On page 236 in the same article, but in a discussion of the two new 10,000 ton treaty cruisers *Pensacola* and *Salt Lake City,* the following sentence appears: "The steam pressure is said to be 700 pounds, though this has yet to be confirmed." This reference to 700 pounds of steam pressure is evidently a typographical error, as it is well and publicly known that the boilers for the two vessels mentioned, as well as for the six later ones now in process of construction, are designed for 300 pounds pressure with no superheat.

This question of steam pressures and temperatures for U. S. naval vessels is an interesting one, usually avoided by our naval and shipyard design engineers. Forgetting the comparatively large number of land plants which operate with steam conditions ranging from 400 pounds with 250° F. superheat up to 1200 pounds with 750° F. total temperature, it should be noted that, at present, several merchant ships are operating with pressures in excess of 300 pounds, and with varying amounts of superheat. The U. S. Coast Guard is now building five cutters whose turbines will operate with steam conditions of 250 pound pressure and 250° F. superheat. The British, besides Parsons' 550 pound pressure, 800° F. total temperature steamship *King George V,* have launched two fifteen thousand S.H.P twin screw, geared turbine passenger ships having Yarrow boilers. The ships are for the Canadian Pacific R.R. and each one has steam conditions of 350 pounds and 650° total temperature, one being an oil fired vessel, the other being a coal burner with mechanical stokers.

It used to be that the U. S. Navy and merchant service were the leaders in marine engineering. We remember with pride that the steamboat, the Kingsbury thrust, the armored vessel, the submarine, the screw propeller, etc., were first used successfully by American engineers. The late Admiral George Melville, U.S.N. (Retired), and his colleague, MacAlpine, financed by George Westinghouse, pioneered geared turbine propulsion against the skepticism of the entire marine world, and the U. S. Navy made the first installation in 1911 in the U.S.S. *Neptune,* four years after the inventors filed their first patents. Since that time our Navy has installed about 12,500,000 S.H.P. of geared turbine propelling machinery, of which over 9,000,000 S.H.P. was built to foreign design, but, strange to say, has made practically no advances toward the greatly improved economies which may be secured by the use of increased pressure and temperature steam.

The writer has said considerably more than he originally intended, when he started this letter. It, however, expresses beliefs which are very evident. It is passing strange that, considering the undoubted ability and leading position of American steam engineers and their advanced knowledge of the art, the U. S. Navy should remain so many years behind contemporary practice, and should specify foreign designed machinery.

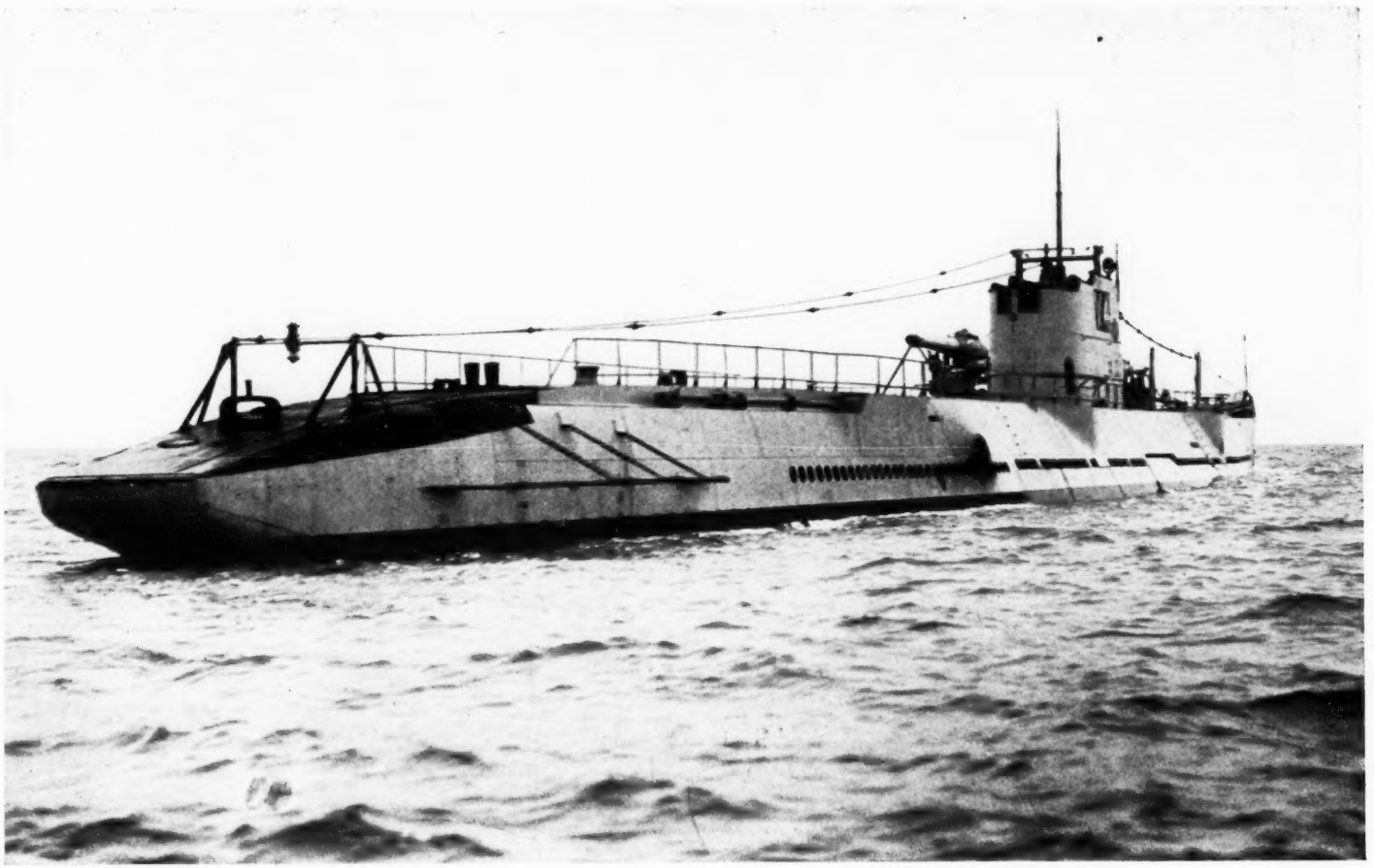




International Newsreel

THE U.S.S. SARATOGA

Our latest type airplane carrier during a speed test off the Pacific Coast recently.



International Newsreel

AMERICA'S LATEST SUBMARINE, THE *V-4*.

The *V-4*, recently completed submarine and mine layer, is of about 2890 tons displacement, has a crew of seventy-six men and seven officers, and contains the most modern and proven safety devices obtainable.

PROFESSIONAL NOTES

2 JUNE TO 1 JULY

COMPILED BY

COMMANDER F. W. ROCKWELL, U. S. NAVY

LIEUTENANT COMMANDER A. C. MCFALL, U. S. NAVY

AND

PROFESSOR HENRY BLUESTONE, U. S. NAVAL ACADEMY

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GREAT BRITAIN

Size of Destroyers

Naval and Military Record, May 30.—It has been suggested that, since the Admiralty are apparently in favor of a substantial reduction in the displacement of capital ships, they might extend the same principle to destroyers. Of course, there is no direct association between the two ideas. The bigger the capital ship the more formidable she should be. This does not apply to the destroyer, the rôle of which is a fixed quantity. That is to say, the original rôle of this type of fighting craft, for one of the features of steady growth in size is that it tends either to confuse perception of original purpose or to change it. At the beginning of the present century the destroyer was a vessel of less than 300 tons displacement. After the Cobra disaster, when there was a clamour in the press for "stronger" and more seaworthy destroyers, the *River* class made its appearance—vessels of 550 tons and 25½ knots speed. They were excellent sea boats, with a good freeboard and high forecastles, but the older school deemed them too big for flotilla work, in which "tip and run" is the governing idea. We appear to have settled down to a displacement of 1,000 tons as the mean standard for destroyers. The improvements which have accompanied this development are a considerable extended sea-keeping endurance and much augmented gun power. How far either of these conditions is of distinctive value to a craft primarily designed to deliver torpedo attack is an open question. If extended sea-keeping endurance is essential, then the modern light cruiser, which has the speed of a destroyer and (in the case of the latest types) is actually fitted with more torpedo tubes should supplant her. The French and Italians appear to be moving in that direction, since both are building torpedo-craft as large as our third class cruisers of three decades ago. The British destroyer of today is practically twice as big as, and carries twice the complement of, the *River* class. She therefore represents double the risk when employed in action. Has she double the chance of success? If so, she is completely justified. If not, then we must seek her additional value quite outside her original rôle. No doubt there is much to be said on both sides. Big destroyers did invaluable work in commerce protection in the Great War. In other words, they were employed in cruiser work, and it is legitimate to argue this is not destroyer work.

Aircraft Attack

Naval and Military Record, May 30.—The airplane having manifestly come to stay as a military weapon, the "infernal ingenuity" of the scientists is now being exercised to render her as formidable as possible in attack. To the ordinary bomb and aërial torpedo has recently been added a delay action bomb, which explodes at between 20 feet and 30 feet below the surface. It is claimed that this would be likely to prove more deadly by acting against the underwater structure of a hull than a direct hit on topsides would be, and that the concussion alone, within a certain limit, would suffice to disintegrate the plates. In effect, this new bomb is a depth charge. Probably the idea which governed its invention is that, whether its direct action is more deadly or not, it widens the prospect of successful attack. If the ordinary bomb fails to hit its target it falls harmless into the sea. If the delay action bomb does hit its target it will prove pretty devastating; if it just misses her it may still accomplish its destructive work.

Yet the navy does not show much tendency to be appalled by the development of aërial frightfulness. Probably it thinks that gunnery is a more exact science than bomb dropping is ever likely to become, and that a 1,000 lb. shell can do quite as much damage as a bomb of similar weight. Moreover, the seaman believes that, when it comes to the real thing and not to mere tests against defenseless ships, he can give the airman more than he is likely to get. Whether this is too sanguine a view or not, it is distinctly one to be encouraged. A highspeed, zig-zagging warship is a very elusive target from the air, especially at such a height as her anti-aircraft batteries would oblige the aircraft to maintain. It would be foolish to ridicule the added menace in sea warfare, but the alarmists are not likely to carry any body of naval opinion with them. Chemical bombs, with a considerable area of effectiveness, might prove more dangerous than explosive bombs. But here again free winds and swift motion would render the employment of such bombs very difficult.

There is so much that aircraft could do with successful results in wartime that we rather question whether attacking warships will be thought worth while. Towards the end of the war our airmen, operating from Plymouth, were very active against German submarines. They often saw them and often bombed them. A submarine is practically a defenseless target. Yet what was the sum-total of this activity?

Naval Fuel

The Naval and Military Record, June 6.—The prolonged discussion upon the merits of various types of fuel for steamships, in which several distinguished experts are taking part, is naturally attracting much interest in the navy, for the question of warship fuel is not only a mechanical problem, it is a strategical one as well. The advantages of liquid fuel are self-evident. A vessel can rapidly refill her oil tanks, even on the open sea, in fair weather. There is none of the heavy manual labor and dirt which attended the business of coaling ship. Then the work of firing the furnaces is greatly simplified, with the result that stokehold complements have been substantially reduced. These advantages, however, mainly are a matter of convenience. On the economic side oil fuel is more costly per unit of horse-power developed. An oil-fired warship loses the protection that was formerly afforded by ten feet deep of bunkered coal behind her broadside belting. On the strategical side the case for coal is a strong one. In the South Wales fields we possess the finest steam coal in the world, and down to the time when it was superseded by oil this was reckoned as one of our greatest naval assets.

On the other hand this country produces no oil at all, and is entirely dependent upon overseas supplies. This disability has been largely neutralized by prevision, and the Admiralty reserves in the United Kingdom are estimated to be sufficient to maintain a war fleet for a whole year without replenishing. Coal in its natural state is not very likely to replace oil in the navy, but the question which is attracting so much interest is as to whether coal in some "treated" form may not prove superior to oil. In naval engineering circles the prospect of any abandonment of liquid fuel for an unknown quantity is not likely to be favorably received, although let it be said that the unknown quantity would be thoroughly tested out before any such step were decided upon. From the national point of view any development which would bring greater prosperity to the languishing coalfields of South Wales would be of immense benefit. The increasing demand for higher boiler pressure is bound to be accompanied by a corresponding demand for higher caloried values, and the experts declare that pulverized coal will give this.

UNITED STATES

Representative Lindsay's Questions on Submarines

U. S. Navy Magazine, June, 1928.—The recent re-opening of the entire question of effectiveness of submarines in offense and defense, brought on by the *S-4* tragedy, resulted in Representative Lindsay, of New York, submitting twelve questions relative to submarines to the Navy Department for information. The questions and answers prove interesting reading to those of our readers who are not familiar with submarine data and development.

(1) *What is the comparative tonnage or number of vessels of the various nations with respect to submarines only?*

The table shown below gives the submarine tonnage of various powers as of October 1, 1927:

	Built	*Building*	*Appropriated for*	*Total*
United States...	84,722	9,000	0	93,722
British Empire..	46,888	11,800	9,000	67,688
Japan	52,266	16,170	9,720	78,156
France	45,069	15,319	16,421	76,809
Italy	17,252	13,528	4,725	35,532

It should be noted that existing tonnage of United States submarines will become obsolete at a rapid rate in the near future. Thirteen years is the estimated useful life of a submarine. United States submarines at present carried on the Navy list will become thirteen years of age as follows:

Date	*Number*	*Tonnage*
Now	10	3,852
1929	4	1,800
1930	3	1,044
1931	28	13,730
1932	22	12,614
1933	9	8,224
1934	4	3,504
1935	8	7,662
1936	19	16,292

1937	8	8,278
1938	5	5,820
1939	1	2,196

(2) *What is the annual expenditure for maintenance and repair, etc., of the submarine class of United States Navy?*

During the fiscal year ending June 30, 1927, $10,272,469 was spent in the maintenance, repair alteration, and operation of submarines.

(3) *Are submarines effective against warships and cruisers, or are these vessels protected by armor plate which is not penetrated by the torpedoes of submarines?*

The torpedo from a submarine is effective against all types of men-of-war. The armor belt in the case of battleships does not extend much below the water line. For protection against torpedoes dependence is placed on two methods:

(a) Compartmentation in all vessels.
(b) Blisters in addition in the case of battleships.

Compartmentation consists, in brief, of dividing the hull into as small as practicable water-tight subdivisions in order to localize the effect of underwater damage. Blisters consist in a series of compartments placed exterior to the hull proper to limit the damage of an exploding torpedo. Battleships with the foregoing elements of design can probably withstand as high as four torpedo hits without sinking, whereas formerly, without this protection, two hits might cause sinking.

(4) *Are there any instances available of fighting ships of any navy having been sunk by submarines? Or any tests made on condemned hulls?*

In the late war Great Britain suffered the following combatant-ship losses from submarines: five battleships, five cruisers, three light cruisers, one monitor, thirteen sloops, one flotilla leader, six destroyers, two torpedo boats, one aircraft carrier, and one mine layer. In every case the battleship was of an obsolete type.

Tests have been made against condemned hulls notably the *Washington* prior to her being sunk in accordance with the limitation to armaments treaty. Special tests were also conducted on the *South Carolina.*

(5) *How many torpedoes are carried by a submarine, and may these be fired while submerged with any effectiveness?*

Submarines are built with from four to six tubes from which torpedoes can be fired. The number of torpedoes carried varies from two or three times the number of tubes.

The most effective method of fire is with the hull of the submarine submerged but with the top of the periscope showing. This reduces the visibility of the submarine to a minimum while allowing the directing officer to see his target. A submarine in this position is said to be at periscope depth. A submarine may also fire its torpedoes when completely submerged by using special methods of firing.

(6) *What is average cost of discharge of a torpedo in actual combat with the enemy?*

The average cost at present of a torpedo with its war head is $14,000.. .

(7) *What is effective range of torpedo discharge?*

A torpedo is effective almost immediately after leaving the point of discharge up to the extreme limit of run, which limit varies with different types of torpedoes.

(8) *Has the submarine any offensive status, or is it a weapon primarily of defense, considering the reduction in submarine attacks following the use of convoys of destroyers, submarine torpedo nets, etc.?*

The submarine has an offensive as well as a defensive status, but no matter whether it be operating offensively or defensively it derives its importance from its ability to take offensive action against enemy ships. Submarines that operate locally—for instance, in the vicinity of the Canal Zone, the Hawaiian Islands, the ports of our Atlantic and Pacific coast—would, in general, be said to be operating defensively, but the efficiency of their operation in these areas would depend upon their ability to attack vessels or fleets that were attempting to interfere with commerce or to bombard our shore positions. This kind of operation constitutes the defensive operations of submarines. Offensive operations are those that pertain to operations on the high seas or in enemy waters, where the submarine seeks to place itself in a position for attacking enemy combatant vessels. It is not possible to lay down any general rule as to which is the more important employment

of submarines. Importance of the employment will depend upon the circumstances of the war at the time. Submarines of all classes can be employed in the purely defensive operations above indicated, but only the larger submarines have sufficient seagoing qualities to enable them to operate offensively in distant enemy waters.

(9) *What is the average rating of effective fire or "marksmanship" for submarines of the United States Navy?*

Submarines are not generally very efficient in their gunfire unless the sea is smooth. They cannot fire their guns as effectively as surface vessels, except at very short range. Their marksmanship, so far as torpedoes are concerned, compares very favorably with torpedo marksmanship from surface vessels.

(10) *Briefly, what is the value of a submarine as an integral part of a well-balanced navy?*

The submarine is a very valuable element of naval strength, particularly valuable for operation in enemy waters since it can go to those waters and remain for considerable periods of time awaiting its opportunity for its successful attack of enemy combatant ships and to observe and report their movements. No other type of naval vessel can maintain itself in enemy waters unsupported for any considerable period of time, because it would be discovered and driven off by superior naval strength of the enemy. The submarine, instead of being driven off, can submerge at appropriate times and thus escape observation. There is no way for a surface vessel similarly to escape observation. You can very well see how disturbing it would be to the naval operations of the enemy if submarines were known to be operating in the vicinity of its naval bases threatening every ship that issued from or returned to such bases.

The submarine has a special value to a fleet in its ability to scout along distances ahead of the fleet without being chased off its station by superior strength of the enemy. When it comes to fleet action, the submarine is a weapon of opportunity. There is no assurance that the submarine in fleet action will be as useful as surface vessels, but in all the steps leading up to fleet action, the submarine may play a very important rôle.

The mine-laying submarine is of value in that, unobserved, it may lay mines in or near the entrances to enemy naval bases and in localities of enemy naval activities. This form of attack may prove very effective in damaging or sinking combatant ships; in addition the constant threat of such mine laying makes necessary considerable sweeping operations which serve to delay or occupy enemy forces.

(11) *In a hypothetical case of having to choose between submarines and fighting vessels of a non-submarine type, would not the choice be for the regular ship? Why?*

This question cannot be answered directly. There are so many factors that enter into the decision that with one set of factors it might occur that the need for submarines would predominate, while with another the need for submarines would not predominate. It is impossible to foresee with any degree of precision all of the factors and evaluate them sufficiently to make a decision in the case. It will oftentimes occur in certain phases of naval war that the submarine will be the sole type of naval vessel that can operate effectively in the execution of the particular task in hand. In other cases the usefulness of the submarine may be distinctly less than the usefulness of surface vessels. In general, a fleet must be built up and organized for the general exercise of sea power. It must be composed of vessels that are indicated by long study of the general world situation, of naval aims, and naval dangers. Such studies and estimates have led the Navy Department to submit for the consideration of the President and Congress a building program that represents the best professional opinion of the Navy. This program includes both surface and submarine vessels.

(12) *What is the advantage of a large submarine of possibly 300 feet over all, as compared with one only 150 feet over all?*

The advantage of a large submarine as compared with a small one is that the area of its operations is not limited to local areas. The small submarine is by its very nature restricted to operations in the vicinity of bases and ports of the United States. It can not go long distances at sea and remain in strategic positions for considerable periods of time. Its cruising radius is so restricted that it must remain near sources

from which it may replenish its fuel, its provisions, and where it may rest its personnel. The small submarine is, of course, much more uncomfortable for the personnel and wears them out quicker than the larger and more comfortable submarines.

The special situations of the United States in the matter of bases makes it necessary for us to build vessels that can cruise long distances at sea. This necessity applies with as much force to submarines as to surface vessels. Notwithstanding the necessity we are under, all nations building what might be called the larger class of submarines, we recognized that the larger the submarine the more it costs and consequently the fewer vessels we can get for a given expenditure. Our effort, therefore, in design is to keep the displacement of individual vessels as low as possible while still incorporating in them the necessary strategic and tactical qualities. This effort has resulted in a design of a vessel below 2,000 tons.

Safety Devices for Submarines. Appointment of Board

New York *Times*, June 29.—Expansion of the submarine into a more formidable warship than the Germans operated in the World War has been marked by many disasters. Safety devices to protect American crews had not kept pace with development when *S-4* was sunk with her crew off Cape Cod by a Coast Guard vessel. In the inquiry into her loss and the vain attempt to save the unfortunate officers and men, it came out that the government had been laggard in working out plans for the security of the undersea boats.

It was shown that inventors had come forward with proposals that had received little consideration. If the Government had acted when *S-51* went down to the bottom of the sea and lay there for months, *S-4* would probably not have been a sacrifice. "I believe," said Simon Lake, a designer of submarines, "that if certain safety features had been installed on the *S-51* and the *S-4*, as referred to in my letter to Secretary Wilbur under date of September 30, 1925, the loss of life would have been materially lessened." He had urged the Navy to install escape or diving compartments in bow and stern into which men could go when other parts of the submarine were flooded. He devised a system of double doors to close automatically when a "predetermined depth of water entered any compartment." Other inventions worthy of attention were hose connections for use by divers, and buoys to rise to the surface and mark the spot where a submarine had gone down.

A board of civil engineers and retired naval officers appointed to look into safety devices and salvage equipment meets today in Washington. It will consider more than 4,000 ideas submitted to the Navy Department after the sinking of *S-4*. Most of them will be dismissed as impracticable, but surely those submitted by inventors of the type of Simon Lake should have full scrutiny. Out of the quest of the board may come devices that will revolutionize design. The personnel promises research of great value. It includes Admiral Charles F. Hughes, Chief of Naval Operations; Rear Admiral Joseph Strauss, who laid the mine barrage in the North Sea; Admiral David W. Taylor, retired, formerly chief of the Bureau of Construction and Repair; Dr. W. R. Whitney of the General Electric Company of Schenectady, and Thomas A. Scott, a salvage expert of long experience.

ITALY AND SPAIN

Modern Units of Italian Fleet

La Revue Maritime, May.—The Minister has decided to begin during the current fiscal year the construction of two 10,000-ton cruisers, four desroyers of the *Membo* type, and four submarines of an average cruising radius. Accordingly, by 1931, the most modern part of the Italian forces will consist of: four cruisers of 10,000 tons, four scouts of 5,000 tons, twelve scouts of 2,000 tons, twenty destroyers of 1,200 to 1,400 tons, twenty-five submarines, of which five will be of 1,400 tons and twenty of 800 to 850 tons. To this group will be added a certain number of scouting boats and destroyers built during the war and completed after the war, most of which are still in good condition.

Spain Places Extensive Modern Program

The Council of Ministers has decided to devote to the construction of naval units an appropriation of 600 million provided in the extraordinary budget of three and a half billion for public works.

This decision is the result of a long press campaign extended from Madrid to the entire Spanish press, showing the obligation

of Spain to give her naval development "the extent required by the importance of her geographical position and her economic recovery."

It is understood that two plans were submitted to the Minister of the Marine: one for the construction of two battle ships of the same type as the British *Nelson;* the other, for the construction of three new cruisers of 10,000 tons.

It is well known that the program pursued includes three cruisers of the above type, three destroyers, twelve submarines, and the complete reorganization of the naval aviation bases.

Furthermore, the Minister of the Marine has been authorized to award a contract for the immediate construction of two destroyers to replace those sold to the Argentine Republic.

The new units will be built largely with the proceeds of the sale.

MERCHANT MARINE

New and Projected Atlantic Liners

The Engineer, June 15.—Speculation continues rife in shipbuilding circles regarding the intentions of the White Star and Cunard Lines in the matter of ordering large new express vessels for their Atlantic services. It would appear that the plans of the White Star Line in this respect are more definite than those of the Cunard Company. It is rumored that the new White Star vessel will be substantially larger than the *Majestic,* and that she may be propelled entirely by internal combustion engines. Should it turn out to be the case that her propelling machinery is to be of this type, it does not seem probable that she will be built to establish a new speed record, but in the case of the projected new Cunarder it is suggested that in speed and size she will surpass any vessel of the company's present fleet. Her speed, according to the rumorists, will probably be twenty-seven knots or a little over, in order that she may compete against the two North German Lloyd vessels *Bremen* and *Europa,* now under construction and designed to attain twenty-six and one-half knots. In the United States the adverse report of the Shipping Board is not, it seems, deterring Mr. L. R. Wilder, of the American Brown-Boveri Company, from prosecuting his plans for the establishment of the projected "Blue Ribbon Line," consisting of thirty-three knot ships, with which a regular four-day service would be maintained between New York and Plymouth. The scheme, it would appear, has a strong financial backing, and with the promise of government assistance, the opinion has been confidently expressed that work on the first ships will be begun at an early date.

Atlantic and Pacific Operators Plan New Ships

Baltimore *Sun,* June 3.—The construction of fast combination passenger and cargo ships, to cost approximately $66,000,000, is being planned by Atlantic and Pacific Coast operators.

This was made known today at the Shipping Board, by E. C. Plummer, vice-chairman, who said he had been informed that three operators on the Pacific Coast and one on the Atlantic contemplated the making of application for loans aggregating $50,000,000 under the recently enacted Jones-White act increasing the Government shipbuilding loan fund to $250,000,000. The loans will represent 75 per cent of the cost of the vessels, the maximum which may be borrowed by shipbuilders under the new legislation.

The ships are to be capable of sixteen to eighteen knots an hour speed. The Pacific operators include the Oceanic Steamship Company, the Oregon Oriental Line, and the American Hawaiian Steamship Company. They plan to build at least six ships.

The Export Steamship Corporation, of New York, previously has signified that it would seek a loan for the construction of four vessels to be operated between Atlantic and Mediterranean ports.

Commenting on the recent reports that the United States Lines, which operate the only exclusive passenger service of the twenty-one Shipping Board lines, would be sold soon, Mr. Plummer declared that the lines "are not in a saleable condition." He said that if the lines were placed in the hands of a private operator they would be unable to compete successfully with foreign North Atlantic lines because of the slow speed of all the ships except the *Leviathan,* which has a cruising speed of twenty-three knots.

Plummer asserted, however, that when the steamers *Monticello* and *Mount Vernon,* which are to be reconditioned and equipped to travel twenty to twenty-three knots in an hour, are placed in the United States Lines, the service would be able to compete with the finest vessels operating in the North Atlantic and then the service could be turned over to a private operator with reasonable assurance that it would be maintained.

Pointing out that the *Monticello, Mount Vernon,* and *Leviathan* would form a fast service capable of weekly mail delivery, Plummer asserted these vessels would make a balanced fleet of the United States Lines. The slower vessels, he said, would supplement the fast ones to serve additional North European ports. He added that the lines were operating on a paying basis and attributed this to superior food served to passengers.

Mr. Plummer declared that the proposed construction of fast ships that would cross the Atlantic in four days was entirely in the future and that nothing tangible had been submitted to the board which would indicate it would be possible to have this type of vessel in service within three years.

Stating that the new merchant marine act offered little aid to cargo ship operators, Plummer said that the legislation greatly encourages construction of fast combination passenger and cargo vessels through mail contracts. The speedy type of ships, he added, is the one most needed by the American merchant marine.

ENGINEERING AND RADIO

Electric Propulsion Prospects

Marine Engineer and Motorship Builder, June, 1928.—A paper entitled "Electric Transmission of Power for Propelling Ships" was recently read before the Rugby Engineering Society by Mr. W. J. Belsey, of the British Thomson-Houston Company, Ltd. Marine engineers are interested in the electric drive at the present time principally because one of the most conservative British shipping companies is now building a turbo-electric liner in this country, the first large vessel of this type to be built in Britain. Mr. Belsey's paper gave the usual arguments in favor of turbo-electric and Diesel-electric drive. In connection with the former, the excellent overall efficiency (alternator, propulsion motor, and excitation) of 92.8 per cent is claimed for an installation of 17,000 s.h.p., 93.1 per cent for one of 22,000 s.h.p., and 93.9 per cent for an 80,000 s.h.p. installation having four generators. We do not agree with Mr. Belsey, however, when he ascribes some of the higher turbine efficiency claimed for turbo-electric machinery as being due to the use of higher speed turbines. Equally high turbine speeds are practicable with gearing, and it is debatable whether the elimination of the astern blading, reduced gland losses, and cross-connection losses credited to the electric drive counterbalance the higher transmission efficiency of the geared installation. The new P. & O. turbo-electric ship will throw light on this question when it has been in service for some time. In view of the excellent performances of several recent geared turbine liners, (e.g., the *Empress of Australia, Orama,* and others), the new electrically-propelled ship has to attain to a very high standard of efficiency in its class if further progress with the electric drive is to be made in this field.

To support his contention as to higher turbine efficiency, Mr. Belsey gives some performance data for a land power station operating with a boiler pressure of 250 lb. per square inch, and a steam temperature of 619° F. at the boilers. The equivalent fuel rate for a ship, assuming generators of ninety-seven per cent efficiency and oil fuel of 18,500 B.Th.U. per lb., is shown to be 0.684 lb. per shaft horse-power per hour, and as this assumes a load factor of forty-six per cent, it is suggested that the results in a ship "would be much better." As the load factor in a ship is influenced by the season of the year, the service she is on and her hull form, it is not possible to suggest how much better than 0.684 lb. of oil the specific fuel consumption would be in practice, but it is unlikely that it would exceed 5/7 per cent in most cases. The figures of power station performance put forward by Mr. Belsey, and upon which he bases his estimates, are exceptionally good. The station contains one 16,000-kW. and two 6,000-kW. turbo-generating sets. The number of B.Th.U. per kilowatt generated is 15,947, a very good performance for the type of plant cited. The boiler-house efficiency is given at 81.89 per cent, and the vacuum (with circulating water at 46.3° F.) is as high as 29.27 in. of mercury. These

figures would be difficult to attain in ordinary sea service.

Despite the exceptionally fine performance upon which Mr. Belsey bases his estimates, it is interesting to note that the single-reduction geared turbine (Parsons' type) steamer *Empress of Australia* is showing, in service, a specific fuel consumption for propulsion only of 0.67 lb. of oil per shaft horse-power per hour. This vessel has two sets of turbines of 10,000 s.h.p. each, each set being arranged in three casings, two of which contain astern blading. The three-stage arrangements gives a maximum number of glands and cross-connections, while the use of single-reduction gearing with a propeller speed of 125 r.p.m. does not give the most favorable ratio of steam to blade speed. It is reasonable to suggest, therefore, that the performance of this, perhaps the most economical steamship afloat, does not represent the limit of efficiency to which it is possible to attain with a geared turbine installation. While we do not wish to uphold geared turbines at the expense of the turbo-electric drive, it is desirable to point out these facts. Furthermore, no actual performance data relating to electrically-propelled steamers comparable with the *Empress of Australia* or the *Orama* are available, and until such information is published (say, for the American turbo-electric liner *California*), the wisdom of making estimated comparisons between geared and electric installations is questionable.

The section of Mr. Belsey's paper which deals with Diesel-electric propulsion is largely given over to the comparison of direct-driven and Diesel-electric motor tugs. The application of electric drive to tugs, when associated with Diesel engines, is a field wherein the system has undoubtedly the advantages over the direct-coupled oil engine. Mr. Belsey makes out a good case for the Diesel-electric tug, but he does not strengthen it when he states that Diesel engine indicator diagrams are untrustworthy and torsionmeters inaccurate, because all such alleged unreliable data must necessarily detract from the value of any comparisons made between the direct and the transmitted drive propositions. Furthermore, the indicator plays an equally important part in the running of the prime movers of the Diesel-electric vessel.

The much-cited advantage of bridge control in Diesel-electric tugs and ferries is mentioned by Mr. Belsey in his paper. While the convenience and value of bridge control cannot for a moment be denied, it might not be out of place to suggest that bridge control could, without great difficulty, be arranged for with the "straight" Diesel-driven ship of any type.

Although Mr. Belsey's paper is one of considerable interest to all marine engineers, many of his statements are, we suggest, open to argument. Several large turbo-electric ships, for instance, will have to be in service for some time and their performances published before Mr. Belsey's claim of a fuel rate of under 0.684 lb. per s.h.p. per hour for a turbo-electric vessel of the 20,000/30,000-ton class will be accepted by most engineers. We would like to see both the turbo-electric and the Diesel-electric systems make headway in this country if they are going to make for more economical ship operation in certain instances. Progress will only be recorded if the electric drive can show improvement over the more usual system in net fuel performance, installation weight, initial cost and upkeep outlay. The shipowner is not concerned with how results are obtained as long as he is certain of consistently realizing them. Now that several electrically-propelled merchant ships of different sizes and types are being built, we will know before long how their performance compares with that of the conventional geared or direct-coupled steam and Diesel installations. The sponsors of the electric drive have no mean task before them, but they are strong in technical equipment, financial resources and confidence. The position of electric propulsion is already a strong one in America, and it will be interesting to see whether its further development in Europe, as exemplified by the new P. & O. liner *Viceroy of India,* is going to be of an important character.

Magnetostriction Oscillators

Outline of paper by George W. Pierce in the *Proceedings of the American Academy of Arts and Sciences,* Vol. 63, No. 1.—April, 1928.—The present paper describes a newly-discovered method of using magnetostriction to produce and control electrical and mechanical frequencies of oscillations in a range of frequencies extending from a few hundred cycles per second to more than three hundred thousand cycles

per second. The method involves the interaction of the mechanical vibrations of a magnetostrictive rod and the electric oscillations of an electric circuit in such a way that the electric currents in the circuit stimulate the rod to longitudinal vibration by magnetostriction and the vibrations of the rod react by magnetostriction on the electric circuit to maintain constancy of frequency.

The constancy of frequency obtained compares favorably with that obtained with the piezo-electric crystal oscillators. For ease of construction and operation the magnetostriction oscillator has a great advantage over the piezo-electric oscillators, particularly in that the construction and adjustment of the magnetostriction vibrators is so simple that large numbers of standards of frequencies all operable with the same electrical circuits may be had at small expense.

The magnetostriction oscillators supply a particularly pressing need in the range of frequencies below twenty-five thousand cycles per second in which range crystal-control is impractical on account of the expense of obtaining sufficiently large crystal vibrators. In the range between twenty-five thousand cycles per second three hundred thousand cycles per second the magnetostriction oscillators and the crystal oscillators have a common field of usefulness. At the magnetostriction oscillators (although active up to two million cycles per second) are feeble with the present arrangement of apparatus. Their harmonics may, however, be employed up to frequencies of several millions per hundred.

This account contains also methods for calibration of the vibrators and their use in the calibration of wavemeters and frequency meters, data on the velocity of sound in various metallic alloys, data on the elastic constants of metals, including their temperature coefficients, description of methods of sound production, and a theoretical investigation of sound propagation in a viscous magnetostrictive medium.

AVIATION

Air Power and Its Applications

EDITOR'S NOTE: The following "Conclusions" are quoted from an article by Group Captain W. F. MacNeece Foster which was too long for complete publication. The same number of the *Journal* contains an excellent article on "Sea Power and Air Power" by Lieutenant Commander C. D. Burney, M.P.

Journal of the Royal United Service Institution, May 1928.—CONCLUSIONS. An effort has been made to outline certain aspects of air power and its application. It remains to sum up our conclusions. They appear to be:

(1) The Royal Navy is vital to our security but cannot, by itself, assure this end. The menace to this country from the air in the event of a continental war is of the gravest nature.

(2) The scope of modern warfare will enormously increase. It has changed now, in fact, to a conflict between nations in which every section of the nation is liable to heavy attack.

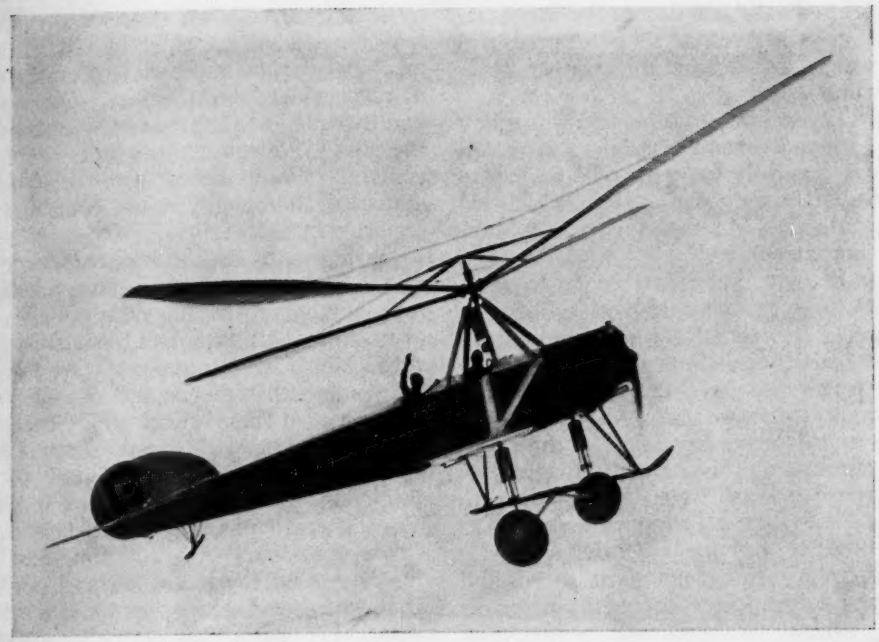
(3) The passive defence of this country by air is at best only a palliative. The inevitable trend of scientific development of air equipment will place the attackers in an ever increasingly stronger position *vis-à-vis* the defence.

(4) In bombing attacks by night, or on days of indifferent visibility, large passenger carrying civil aircraft may be usefully employed after comparatively minor modifications.

(5) Ethically and strategically it is desirable to limit the grosser, more barbarous, phases of air warfare. On the other hand, it is absolutely essential to be prepared for but also to prevent such onslaughts.

The Autogiro—Its Future as a Service Aeroplane

Journal of the Royal United Service Institution, May, 1928.—By Señor Don Juan de le Cierva. In 1925 the "Autogiro" brought by me from Spain at the invitation of the Directorate of Scientific Research of the British Air Ministry was greeted as one of the most important aëronautical inventions of recent years, and as the greatest step in aërodynamical progress since the Wright Brothers first proved that flight could be achieved with the help of the internal combustion engine. Since that time the Cierva Autogiro Company, Ltd., which was formed in this country to develop my invention, has been engaged, in co-operation to a great extent with the Air Ministry, in a course of experiments with the autogiro principle from which many improvements and developments have been discovered, and



Photograph by the Topical Press Agency

HINKLER FLYING

THE "AUTOGIRO"

a sufficiently standard design of construction has been arrived at to produce useful performances for naval, military or commercial purposes.

The 1925 machine was the result of many years work and of many trials and disappointments, and it may be of interest to recount shortly the various steps which led to the production of the autogiro as a practical flying machine.

It was in 1911 that I first began to work at aviation, experimenting with gliders at first and afterwards with power-driven airplanes of the ordinary type, until in 1918 a bad crash of a large biplane with three engines due to stalling from loss of flying speed diverted my mind to the problem of eliminating this danger entirely. For this purpose it was obviously necessary to achieve some sort of contrivance such as would produce a flying machine with stability entirely independent of its speed, and in 1919 the idea came to me of using as a lifting surface two windmills revolving on the same vertical axis in opposite directions. The windmills were four-bladed and were driven solely by the wind. From this method of drive arose the name "autogiro" by reason of the fundamental characteristic of the rotor blades turning automatically without the need for any extraneous power; it is this which extinguishes the autogiro from the unsuccessful helicopter. The axis of this windmill was mounted on an ordinary airplane fuselage with an engine driving a four-bladed tractor screw. The controls were the usual airplane elevator and rudder with a single aileron mounted vertically on the top of the axis. The problem was not solved with this machine in spite of many modifications made as the result of experiment.

The next entirely new type evolved had a single windmill with three cantilever blades capable of being set at varying incidence by the pilot so as to adjust the resultant lift to right or left at will. The first attempts with this machine were encouraging, but ultimately, after the machine had been damaged and modified and reconstructed nine times in the course of the experimental work, it seemed clear that the solution was not to be found by this design.

The third type of autogiro had a lifting windmill of five rigid blades heavily braced to the axis by streamlined high tension steel wires, lateral control being obtained by means of a large elevator divided into two independent parts, right and left. This machine was an improvement on the others in respects of lateral balance, but it always had a tendency to fall over sideways which the divided elevator was not sufficient to control. Four times was this machine damaged and rebuilt in the course of these experiments.

During its trials, the idea had occurred to me to make use of articulated blades and my fourth type of machine embodied this principle. This type had a single windmill with four blades, but these were hinged at the root so that they could move freely up and down in the vertical plane, beating the air, so to speak, without any sensible change in their geometrical incidence. Rubber shock absorbers kept the wings in position when at rest so as to prevent them flapping down too low. In rotation centrifugal forces act on the blades to such an extent as to keep them nearly perpendicular to the axis. The aërodynamical and mechanical problems thus evolved are highly complex but, speaking generally, the system of articulating the blades at the axis is to form a very flexible system so far as lift is concerned and a system tending to ease in maneuverability and steadiness in sudden gusts.

The difficulty of the first machine of this type was that of lateral control which was provided by tilting the axis to the right or left. This tilting control, however, proved to be too difficult for the pilot to work and many crashes resulted in the course of experiment with this machine, which was reconstructed or modified no less than fifteen times in all. Finally, I had recourse to a better system of lateral control, fixing the windmill axis rigidly and providing two small non-lifting ailerons at the end of streamlined spars.

Thereafter the machine which had already demonstrated the value of the articulated blades was ready for real flight, and in January, 1923, it flew across the aërodrome at Getafe at a height of several meters. At the end of the same month it carried out a four minute flight at a height of twenty-five meters at the Cuatro Vientos Aërodrome near Madrid in closed circuit officially observed and controlled. This was, I believe, the first real flight ever carried out by a heavier than air machine differing from the conventional airplane and free

from risk of disaster owing to loss of flying speed or difficulty in landing.

The next type had only three blades in the supporting rotor. This carried out several successful preliminary flights but was ultimately broken up by an accident while taxi-ing.

After this experiments were continued by the Spanish government authorities and the third machine constructed under their auspices was the one which was successfully demonstrated at Farnborough and in France at Villacoublay. Prior to these demonstrations, Captain Loriga of the Spanish Military Aviation Department had made several successful flights and vertical landings in this machine, including a cross country flight between the Cuatro Vientos and Getafe aërodromes. A machine exactly similar to this one was built by Messrs. A. V. Roe and Company, and was demonstrated at the Hendon Air Pageant in 1926.

Much has been done and great advances have been made in design resulting in improved performance since that date, at which time I was satisfied with merely showing that autogiro could fly, and that, once in the air, it had the essential new qualities of safety from stalling and of freedom from danger in landing. Since then my task has been to produce aircraft on the autogiro principle giving performances comparable in every respect with the ordinary fixed wing airplane, while, at the same time, retaining the new qualities already proved and demonstrated. Some seven or eight machines of different types have been constructed during the last two years, mostly by Messrs. A. V. Roe and Company, of Hamble, to the order of either the Air Ministry or the Cierva Autogiro Company, Ltd., and extensive experiments have been carried out with these leading to modifications from time to time in the shape of rotor blades, angle of incidence of the blades, and in details of construction. In the course of these experiments there have naturally been a few accidents, all of which were attributable to mechanical or constructional defects and not to any basic defect in the principle of the machine, and in none of which has any serious damage been done either to pilot or passenger.

As a result of this two years' work we have now evolved a more or less standard design of machine. This, with an engine developing about 180 h.p., attains a top speed of some 95 to 100 miles per hour, a cruising speed of 80 miles per hour and a climb of about 500 feet per minute.

From all these experiments four points of the utmost importance have been definitely established:

(a) The machine is much more easily controlled than an ordinary aëroplane;

(b) It is inherently and automatically stable without requiring the continual attention of the pilot to the controls, and the objectionable effects of bumpy air conditions are practically entirely eliminated;

(c) The machine cannot stall. Under conditions which would normally produce stalling the machine merely loses height slowly without in any way affecting its stability;

(d) The machine is able to descend and land substantially vertically at a velocity of descent equal to that which it would have were it supported by a parachute with a surface about twenty times that of the total wing surface of the windmill. Even when landing at a glide of 30° the machine moves forward only a few feet after landing.

There are other and secondary, but nevertheless interesting, advantages such as simplicity of construction, facility of dismantling and of assembling and adjusting.

Service Uses

In regard to its particular application for warlike purposes the following points will be of special interest. For observation, in which term is included artillery and general air coöperation, reconnaissance and photography, and for bombing machines or carriers of troops the advantages of the autogiro over the fixed wing airplane may be shortly stated as follows:

(1) The unobstructed view downwards;

(2) The low minimum speed obtainable and the possibility of hovering substantially vertically over a given spot against a 10-mile an hour wind;

(3) The relative ease of control over mobile targets;

(4) The ability to land without difficulty at night and in fog;

(5) The reduction of disturbances to the machine due to bumpy air conditions;

(6) The ease of control, making it possible for a pilot to give more attention to external matters;

(7) Comparative invisibility; at a dis-

tance the rapid rotation of the windmill gives a certain degree of invisibility which is not possible in the case of the spread of the wings of the fixed wing airplane.

This latter advantage is one equally applicable to scouting and fighting machines, as also are some of the other advantages quoted above. Further, it is maintained that even without allowing for the greater aëronautical efficiency expected, it will be possible to construct a much faster fighting machine with the additional advantage that it will be a machine capable both of easy maneuverability and of being able to stop practically dead in the air. My reason for maintaining the possibility of constructing a much faster machine is that in an ordinary airplane with fixed wings the top speed is restricted by the necessity of having a reasonable landing speed, whereas with the autogiro system it is possible to calculate the surface in such a manner as to obtain the highest possible maximum speed with a sufficiently low landing speed comparable with that of an ordinary touring machine with fixed wings.

A further advantage from a service point of view is that, in the event of one or perhaps two of the rotor blades being damaged by enemy fire, or even being shot away, it is probable that the machine would be able to make a landing without any serious damage to pilot or observer. In practice, an autogiro has lost one wing in the air and yet landed without disaster.

For naval uses particularly, the autogiro offers a complete solution of the important problem of rapid take-off from a ship, and more especially of landing on a comparatively small deck, irrespective, to a large extent, of the direction of the wind in relation to the ship's course. It is obvious that such capabilities in naval aircraft will materially simplify the tactical difficulties in the employment of aircraft carriers with the fleet, while permitting improved protection and armament for the ships themselves. A further advantage, from the naval point of view, is that a torpedo-carrying autogiro can be so maneuvered as to avoid the steep dive of the torpedo on discharge which it is almost impossible to do with the fixed wing airplane.

In the case of seaplanes it is maintained that an autogiro can far more readily alight on and take off from rough seas than is possible with the ordinary fixed-wing plane.

To all these advantages must be added the primary one of safety from accident. This great main asset can be estimated at its full value when it is realized that at least 75 per cent of the loss of life and damage to material during the late war was due to accident and 25 per cent only to enemy action.

With reference to the suitability of the autogiro for landing in fog, it is pointed out that observations made from a captive balloon at Croydon on a night of very thick fog extending up to about 1,000 feet showed the possibility of landing without danger, provided descent can be made almost vertically, since the fog piercing lights are effective in a vertical direction only. Landing, therefore, by such lights through fog with an autogiro would be comparatively simple, whereas landing with an ordinary airplane would be practically impossible.

Other maritime uses occur to one such as the conveyance of passengers or despatches from ship to shore by autogiro without the necessity of the ship putting into port.

Some criticism has been leveled at the autogiro to the effect that its performance must of necessity be inferior to that of an ordinary airplane because, it is argued, a rotating wing must always do more work and therefore absorb more power in its movement from one point to another than a fixed wing, since it must traverse a longer route; but this criticism does not allow for the beating or pulsating motion of the hinged rotor wings of the present design, the actual output of which has been proved and generally accepted to be superior to that of fixed wings. Further, there appears to have been some confusion between wings rotated automatically and the mechanically driven wings of attempted helicopters. The drive of the latter by an engine produces a motion imparted rotatively to the air as in the case of an ordinary propeller, whereas the rotation of the windmill of the autogiro, apart from mechanical friction which is negligible, does not involve the expenditure of any mechanically produced power. A further basis for a relative increase of output in the case of an automatic freely rotating wing system is the greater speed of the wings relative to the air which necessarily improves the lift-drag as well as does the beating movement of the hinged wings of the rotor.

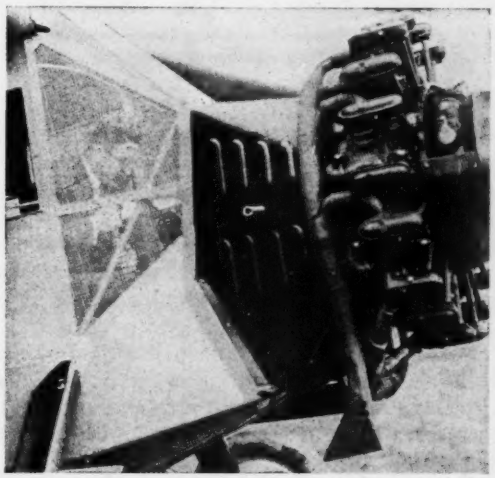
One matter still remaining to be solved is the best method of starting the windmill so as to obtain a sufficiently fast initial speed of rotation to the wings in light winds to attain as nearly as possible vertical ascent. This, obviously, is a development of special importance in connection with naval uses for the autogiro. There are several methods in view to make the machine self-contained in this respect, but in the case of machines working from ships or fixed starting and landing grounds a sufficient start to the rotor can easily be provided by exterior power. Such problems are comparatively simple mechanical problems which are being fully studied and investigated. In the ordinary course of evolution many advances will doubtless be made, not only in methods of starting the windmill but possibly in the controls, in the general performance of the machine and in constructional details.

In conclusion, the fact remains that, even without such aërodynamical or constructional modifications, machines have been constructed on the autogiro principle giving performances at any rate equal to that of the fixed wing airplane, which are simpler to control, incapable of stalling and possess the ability to land substantially vertically without run forward after landing.

Engine Exhaust Silencers

Aviation, June 18.—By Richard M. Mock. —Elimination of noises in airplanes seems to be a general tendency in design. The inconveniences of the roar of the power plant are apparent and it is natural that one's attention should be directed to the principal source of noise—the exhaust. Of course, the sounds given off by the propeller, as well as that of the engine itself, are considerable factors, but it would be useless to attempt to eliminate these until the exhaust of the engine has been quieted. Considerable effort, both in this country and abroad, has been directed to the silencing of engine exhaust noises. Abroad, mufflers are more common than in the United States where long exhaust pipes or exhaust manifolds with "silencing" ends are increasing in use.

The loss of engine power, and also the tendency to burn valves when operating in hot climates, through increased back pressure in the exhaust muffler has been one of the "bugbears" of the engineer. However, it has been demonstrated that, with proper design, power loss may be decreased to a minimum, or, in some cases, the engine power increased. In addition, an exhaust silencer, of good design, has the advantage of eliminating the flames of the burning gases from the view of the pilot for night flying. Objections have been raised because of the increased weight and added air resistance, but with present day refinements in airplane design these objections have been reduced to the point where they are overshadowed by the advantages in the reduction in sound. Apart from the comfort of the airplane passengers, pilots, and those living



Showing the squeeze end type of silencer on the exhaust of a "Whirlwind" installed in a *Fairchild* monoplane

in the vicinity of an airport (which is really paramount), sound reduction is of considerable importance in radio communication with airplanes as well as the deafening effects of long flights.

The standard aircraft engine, on most production planes, has an exhaust manifold which shows little effort to silence the exhaust. The most common type of manifold, on radial engines, is a ring for collecting the exhaust gases and allowing these to escape through vents at the bottom. The engine with the cylinders in line usually has a common collector manifold mounted on each bank of cylinders, with an opening at one end. On some designs there are short stacks on each cylinder or a group of cylinders. Each type of exhaust produces a dif-

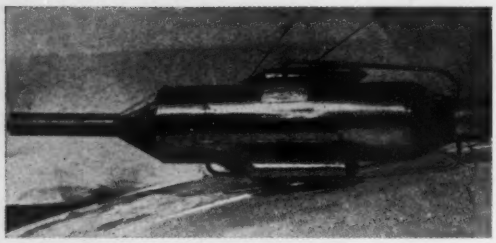


Illustration of the type of muffler being produced by Southern Airways, San Antonio, Texas

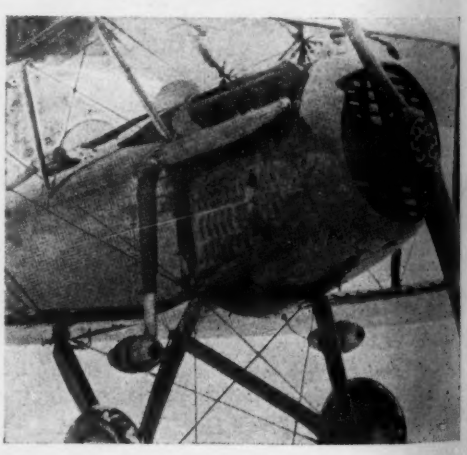
ferent type of noise, and from casual observation it does not appear that any consideration of the elimination of noise has entered into most manifold designs. Most American engine manufacturers do not supply exhaust manifolds but leave their construction to the airplane manufacturer.

Noises can be eliminated from an engine exhaust by slowly reducing the velocity of the burned gases. This may be accomplished by three methods: regular expansion, change of direction, or surface friction. Most exhaust silencers employ a combination of two or three of these. The simplest type of silencer is the long exhaust pipe, common on some Fokker planes. The exhaust manifold is connected to a flexible tube suspended longitudinally below the fuselage extending back to a point under the cabin. The gases expand gradually as they approach the end of the tube and their velocity is decreased by the friction of the walls of the tube. This method causes only a slight back pressure and the noise can be directed away from the cabin. The usual type of cockpit heater reduces the noise slightly by this method as it requires a somewhat longer exhaust pipe than is normally required.

The method of changing the direction of the gases and thus reducing their velocity, such as by the use of baffle plates as on automobile mufflers, causes too great a reduction in power to warrant its use on aircraft engines. In addition, the installation is usually quite heavy. Another method of changing the direction of the gases and thus slowly dissipate their energy is that of the exhaust manifold with the so-called "silencing" ends. The end of the exhaust pipe is either completely sealed or partly closed, while the wall is perforated with small holes having an aggregate opening more than sufficient for the exit of the gases. The silencing end of the exhaust pipe is usually obtained by flattening out the round exhaust pipe near the end, thus obstructing the free exit of the gases. It is understood that this type was first used on Spads during the war. It has the advantage of being able to be combined with the long exhaust pipe, which tends to reduce the noise still further. It causes practically no addition in weight, and only a slight decrease in power. The type with the end completely sealed causes a power loss of approximately one per cent, while with the end partly open the loss is negligible. However, as a noise reducer this type, with the end open, is not as effective as some others.

Standard on Fairchild Planes

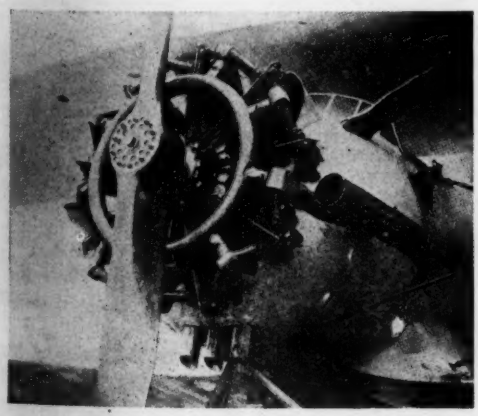
The above type of silencer is now standard equipment on Fairchild planes. The exhaust of the radial engine is carried through a ring manifold with two openings at the bottom, one on each side. One opening is connected to an exhaust pipe fitted with an exhaust heater connected to the cockpit; the other is fitted with a form of silencing end. This pipe appears to be flattened out near the end that is, it tapers in thickness and is widened near the end so that it resembles a triangular wedge. The sides of the wedge are perforated with round holes for the exit of the exhaust gases. According to figures supplied by the Fairchild Company, this type causes an almost negligible power loss; there is a



Showing combination whir and venturi type muffler developed by the Dayton Wright Airplane Company installed for test purposes on an Army plane

back pressure equal to a column of water one-half inch high. The additional weight is only three quarters of a pound and the end reduces the exhaust noise sufficiently to warrant the increased cost of production and the additional weight.

A modification of this type is the "bayonet" or "cone" type of exhaust pipe opening, developed by the Curtiss Aeroplane and Motor Company. This consists of a tapered end to the exhaust pipe. It decreases in cross section towards the end and has a longitudinal opening running the length of the tapered portion. There are no perforations in the wall, the longitudinal opening being sufficient for the exit of gases. This type is common on radial engines, with one of the silencers on each cylinder. Installations have been made on some engines by having one long "bayonet" exhaust opening on a common manifold for all or a group of cylinders. The end weighs no more than a short exhaust stack and offers less air resistance. The power is hardly affected and the noise is somewhat reduced. This type of exhaust stack, for that is really what it is, can be produced fairly cheaply as it consists only of a sheet metal rolled up into a cone with the seam left open, spaced by washers placed between the pieces of metal. It is understood that it is protected by patents held by the Curtiss company. The type with individual stack for each cylinder, as produced by the Curtiss company, averages 1.3 lb. for the Wright Whirlwind and 1.15 lb. each for the Pratt & Whitney Wasp.



Rochat-Barthelmy exhaust silencer on a *Spad* 56 powered with a 380 h.p. Jupiter engine. There are two silencers, one on each side, 29½ in. long and weighing 19.85 pounds

As the Whirlwind exhaust port is on the side of the cylinder there is a bend in the stack, making it slightly heavier.

A somewhat similar muffler is that now installed on Buhl planes. It consists of a long exhaust pipe carried below the fuselage, as far back as the cabin. The pipe tapers in section and has half round openings on one side to provide for the exit of the gases. It is a combination carburetor heater and cabin heater as well as exhaust silencer. It is said to be exceptionally quiet, especially as it carries the noise away from the occupants of the plane. The weight is approximately the same as the usual long exhaust pipe but the installation is more efficient, though more costly. It causes only 0.10 in. of mercury back pressure in the manifold and does not appear to effect the performance of the planes as the engine has the same speed with and without the manifold.

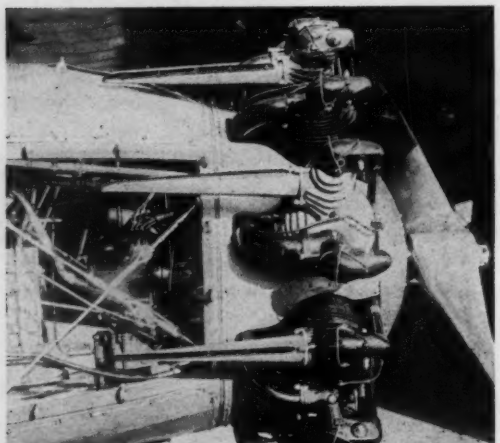
Tests Made on a Liberty Engine

Another type of muffler that decreases the velocity of the rapidly expanding gases by changing their direction, is the "whirl" type. The gases enter a normal exhaust pipe eccentrically, usually at a tangent to the pipe, which causes the gases to rotate or whirl in the exhaust pipe, slowly reducing their velocity. These mufflers were tested on a Liberty engine (one for each cylinder bank) by the Matériel Division of the Army Air Corps and were found to cause an almost immeasurable decrease in power, being approximately 30 r. p. m.. at full throttle. It is stated that the noise was so reduced that on a DH the whistling of the wires, rattle of the valve gear, and noise of the propeller predominated in the sounds which could be heard.

It was stated above that a muffler, if properly designed, would increase the power of an engine. This may be done by utilizing the airstream, to create a negative pressure in the engine exhaust manifold and thus reduce the back pressure, drawing the burned gases from the cylinders at a faster rate than normal and in this way increase the speed of the engine and the power. The Venturi type of muffler which is rapidly becoming more popular because of its high efficiency, can do this. It consists of a Venturi tube exposed to the airstream and surrounded by an expansion

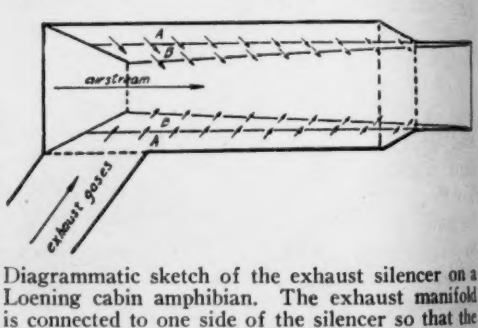
chamber connected to the exhaust manifold. The exhaust gases enter the expansion chamber which serves to regularize and slowly reduce their pressure. From there they are sucked into the Venturi, which is at less than atmospheric pressure because of the high velocity of the airstream passing through it. From the inside of the Venturi the gases continue out into the air current. Flaming gases enter the Venturi and are completely burned before their exit from the muffler, concealing the flames from exterior view. The first Venturi type of muffler is understood to have been used on racing automobiles about 20 years ago.

Perhaps the best known airplane muffler of this type is the "R.B." muffler, used extensively abroad and manufactured by Rochat and Barthelmy, Paris, France. It consists of a metal cylinder with the exhaust manifold pipe welded to one side. Inside the cylinder is a sort of Venturi with the back portion perforated with small holes or gills. The ends are open to the air so that when the airplane is in flight or the device is in the slipstream, air passes through the Venturi, creating a negative pressure in the rear walls where the gills are located. The negative pressure increases the velocity of the exhaust gases inside the device and the gases leave through the small gills and mix with the air that has entered the front end of the device. The fresh air contributes, in part, to the combustion of the gases on their issuance from the gills. This takes place inside the muffler so that the flame of the burning gases cannot be distinguished from the outside. According to the manufacturer, the noise of the exhaust is eliminated and the pilot and passengers can converse in moderate tones. The climb and high speed of a plane is almost identical with and without the R.B. muffler, the difference being so slight it is negligible. The silencer weighs 19.85 lb. and two of these, one on each cylinder bank, installed on a Hispano-Suiza 300 hp. engine weigh 55 lb. with complete manifolding. The muffler is 2 ft. 5½ in. long and has an overall diameter of 6.3 in. The smallest diameter of the inner tube, or Venturi, is 2.37 in. This point is 7.8 in. from the front end.



The Curtiss "cone and bayonet" type of exhaust on a Pratt and Whitney *Wasp* engine installed in a Curtiss *Hawk*

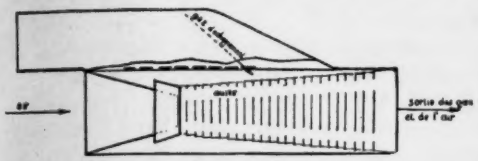
The muffler installed in the Loening commercial amphibian is of the Venturi type combined with the whirl type. A single muffler is used, connected to the top of the exhaust ring behind the cylinders of the Wasp engine. The silencer is slightly larger than the R.B. type, as only one is used for all the cylinders. The installation weighs 95 lb. complete with exhaust manifolding. It should be noted that the muffler is some distance from the engine, above the upper wing, and is connected by a large pipe. In design, it resembles the R.B. type except for a few details. The gills have been replaced by small holes and the shape of the Venturi has been simplified. The exhaust manifold, instead of being connected to the expansion chamber concentrically, is connected on one side so that the gases enter tangently and swirl in the expansion chamber. A baffle in the expan-



Diagrammatic sketch of the exhaust silencer on a Loening cabin amphibian. The exhaust manifold is connected to one side of the silencer so that the gases swirl as they expand passing from chamber (A) to chamber (B) and then into the airstream.

sion chamber also tends to reduce their velocity. On the ground, with the muffler in the slipstream, it increased the speed of the Pratt & Whitney 400 hp. Wasp engine from 1,630 to 1,660 r.p.m.

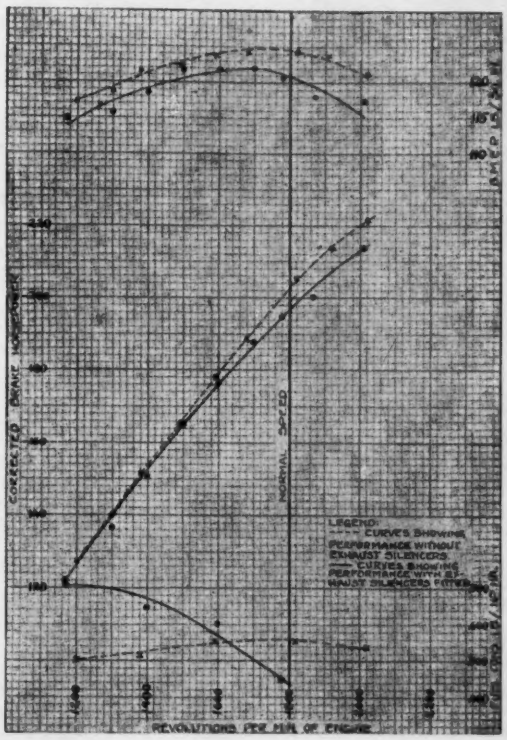
A somewhat similar affair is that designed for the Army a few years ago by the Dayton-Wright Airplane Co. This consists of a streamline body of sheet metal with both fore and aft ends open. Inside is a modified Venturi of sheet metal perforated with small holes. The space between the Venturi and the outside sheet of metal is called the expansion chamber. This has the exhaust pipe connected to it on one side so that the gases whirl in the chamber. In operation it is essentially the same as the



Drawing of the French "R.B." muffler. Translation: gaz = exhaust gases, quies = gills, sortie des gaz et de l'air = exit of the gases and air.

types described above. It is more streamline and somewhat cheaper to make as it consists of two sheets of metal welded together at the ends and to a pipe connected to the exhaust manifold. An experimental installation of this type has been placed in a Fairchild monoplane, and, though the noise was dampened considerably, the power loss and weight was thought too great to warrant its installation as standard equipment. Two mufflers of this type were installed, one on each side of the engine, and they are said to have caused an increase in back pressure in the exhaust manifold equal to a two inch column of water. Each of the mufflers weighed approximately 10 lb. They were about 13 in. long and 7 in. in diameter at the maximum section. The Venturi opening was about 3 in. in diameter at the ends, the forward end being slightly smaller. The minimum section was 2½ in. in diameter. The Army Air Corps made some tests with this type of muffler in 1923 at McCook Field, Dayton, Ohio. A Wright Model E engine was used with the muffler fitted to each bank of cylinders. The power loss was about 5 hp. at the rated speed of 1,800 r.p.m. This is equivalent to a decrease of about 30 r.p.m. The device silenced the engine so that noise of the propeller, valve gear, etc., predominated.

Southern Airways, Inc., is in production on a muffler claimed to increase the power of the engine as well as to silence the exhaust noise to a point where it is negligible. No data is available, at this time, on the detailed construction of the device. It appears to have some sort of baffles to reduce the velocity of the gas while a by-pass on the


CORRECTED BRAKE HORSEPOWER
NORMAL SPEED
REVOLUTIONS PER MIN. OF ENGINE
LEGEND:
---- CURVES SHOWING PERFORMANCE WITHOUT EXHAUST SILENCERS.
— CURVES SHOWING PERFORMANCE WITH EXHAUST SILENCERS FITTED.

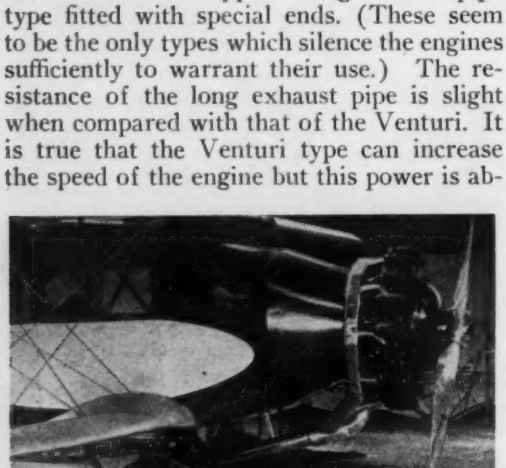
Reproduction of curves showing full power B.M.E.P. and specific fuel consumption of a Wright model "E" engine operating with and without exhaust silencer.

sides overcomes the differences in pressure. The gases enter the muffler through an opening about twice the diameter of that used for the exit of the gases. It is said to be so constructed that when the engine is started a vacuum is formed which draws the exhaust gases from the cylinders at a faster rate than normally; the tubes on the sides create this vacuum. It is also stated that the device does not overheat and that it increases the power of an OX-5 engine from ten to twelve per cent. The weight is not given. William Werner von Falkenstein is the designer.

Another newly designed muffler, on which there is but little information, is one built by an engineer in Oslo, Norway. It is also stated to create a vacuum. It weighs 22 lb. and when installed on a "Kaje" machine, it is claimed that the speed of the engine, which is normally 1,400 r.p.m., is reduced by 20 or slightly over one per cent.

The general tendency in the installations of exhaust systems is to have an exhaust below the fuselage. This is due to the increasing use of cabin heaters and the desire to keep the exhaust flames out of view and to carry the exhaust noises as far from the cabin as possible. A muffling end on this pipe would decrease the noise to a minimum and eliminate the flame. When the engine is running at cruising speed, the noise of the propeller and the engine parts is not as bad as at full throttle. It has been found that some mufflers silence the exhaust appreciably and cause little loss of power at cruising speed but that at full power the noise reduction is practically negligible. This might suggest the use of a by-pass, so that when full power is desired the muffler could be eliminated. However, this tends to complicate the installation more than seems necessary.

It appears that the ultimate muffler will be of the Venturi type or long exhaust pipe type fitted with special ends. (These seem to be the only types which silence the engines sufficiently to warrant their use.) The resistance of the long exhaust pipe is slight when compared with that of the Venturi. It is true that the Venturi type can increase the speed of the engine but this power is absorbed from the airstream and therefore whether or not it does increase the overall efficiency of the installation is questionable. The decrease in pressure in the exhaust manifold increases the rate of exit of the exhaust gases appreciably with a similar increase in power. It is possible to design this type so that it has less air resistance than the R.B. or the Loening mufflers; the Dayton Wright type of Venturi, tested by the Army and by Fairchild, is a step in this direction. It seems that these test units were too small and therefore caused a decrease in power. Though the Venturi type is more complicated and in some cases heavier than the long exhaust with a special end, it seems to reduce the noise more efficiently. However, too little experimental work has been done to draw any definite conclusions as to the most efficient type of muffler. This applies especially to the type of end for the long exhaust pipe. Most installations, made to date, have been quite crude and to the writer's knowledge, no thorough tests have been made along these lines.



Showing the long tapering type of exhaust manifold with side opening fitted on a "Whirlwind" engine in a Buhl "Air-sedan"

The question of noise in aircraft is drawing the attention of many aëronautical engineers and it is expected before long that the commercial passenger plane with a roaring engine will be a thing of the past. There seems to be little hope of total elimination of the noise of the propeller. However, cabin designs are being worked out with more consideration for the comfort of the passengers and noise is being reduced either by silencing the exhaust or by proper proportioning of the size and location of windows to the insulation in the walls of the cabin.

MISCELLANEOUS

Aircraft Carriers—A British Editorial

Naval and Military Record, May 23.—The statement that the United States naval authorities refused acceptance of the aircraft carrier *Lexington* owing to her behavior—or misbehavior, as the case may have been—during her trials attracted considerable interest and speculation in British naval circles. The *Lexington* and her sister ship, *Saratoga*, were laid down respectively at Quincy, Massachusetts, and in the New York Shipbuilding Yard as battle cruisers of 43,500 tons displacement. Under the Wash-

ington Agreement it was decided that they should not be completed as capital ships, but might be converted into aircraft carriers. The abolition of armor protected and turrets resulted in a reduction of draught by about 10,000 tons displacement. The designed engine power of 180,000 s.h.p. was adhered to, estimated to give the vessels a speed of 33 knots. According to one statement it was owing to machinery failure that the further trials of the *Lexington* were "indefinitely postponed," but apparently this was not an official announcement. The two ships have been a very long time undergoing the process of conversion, for the *Saratoga* is not due for completion for another year yet.

Both in the British and United States Navies there is a general impression that these craft are too big and unwieldy for their job. The largest of our own aircraft carriers is equipped with six flights of fighting and scouting machines. The American vessels carry double that number—72 machines. It is admitted that, even with their enormous deck space, they could never employ more than half this number coming and going under the ordinary conditions of action, and therefore the remainder must be regarded as a reserve. The Japanese have recently completed the largest aircraft carrier in the world, originally designed as such—e.g., not converted—and she displaces 27,000 tons. There has been a good deal of discussion of late as to the best mean size for an aircraft carrier, but, like all questions affecting naval design, the difficulty in arriving at a conclusion is that various conflicting and contradictory conditions have to be taken into consideration.

From the airman's point of view—rather an important point of view—the bigger the ship the better. He wants length for taking-off, and he wants both length and breadth for the more difficult task of landing at sea. But the military disadvantages of the very big ship are self-evident. In the first place, she represents the undesirable principle of the concentration of too large a proportion of total fighting power in one hull. If she is lost the blow is a very serious one. In the event of a non-combatant ship, which the aircraft carrier strictly is, the bigger target she presents the greater the risk of her being lost. As against this risk she has the intangible protection of high mobility. The *Courageous* class, which have been adapted to the air service in our own navy, have the same speed as the two *Lexingtons* and it is very improbable that any vessels designed specially for this work in future, whatever their size, will be of lower speed. In a fleet action the aircraft carriers on both sides would be objects of early and pressing attention. Their tactics would probably be to remain well below the horizon, for it is not the business of those on board of them to observe the course of the battle. Destroyers and very high powered cruisers would be their chief aggressors. Enemy aircraft would have enough to do in looking out for themselves and after themselves against our own airmen without trying to destroy the floating aërodromes.

These, of course, are the considerations which arise in regarding the aircraft carrier as a fleet unit. But they would have to be very much modified if we contemplate her scope for independent operations. An aircraft carrier with a seakeeping radius of, say, 5,000 miles might carry warfare to an enemy country beyond the reach of airplane flight. In such a case the bigger the ship and the more machines she carries the better her prospects of success. With the development of the launching catapult and the consequent ability of big warships to effectively use aircraft themselves, it may become a question as to whether the aircraft carrier is of very distinctive value as a fleet auxiliary. Probably the old argument that numbers always count will be advanced as sufficiently disposing of this point. But as yet we can have no very clear vision as to the part the airmen will play in a sea battle as distinct from the part they are intended to play. They will most probably develop a battle of their own in the central view, because each side will be desperately keen to prevent the other from gathering and imparting intelligence, and the only way to do this is by attack.

Aircraft Carriers—French Comment

Naval and Military Record, June 6.—By J. C. Gautreau.—The Senate Marine Committee, under Count de Kerguezec, has reported favorably on the series of realistic exercises and experiments they witnessed on board the 22,000-ton porte-avions *Béarn* under varying conditions of speed and of weather in the Western Mediterranean. The

Béarn, although she is handicapped by low speed (twenty knots), is well suited by her steadiness, roomy installations, and platform for the rôle she is called upon to play in the Toulon battle fleet, the sea speed of which does not much exceed 18 knots. Her flying equipment has been minutely studied by practical men is probably surpassed only by the latest British seaplane carriers of the *Courageous* class, that embody the exclusive experience that the London Admiralty gained within the last decade. The acrobatic feats performed, as routine work, by the picked aviators of the *Béarn* brought home to the distinguished senators the need of a much strengthened aërial wing, to comprise a majority of young officers specializing in aviation. The possibilities of seaplane carriers for attack of coasts were vividly illustrated, as also for securing and surprise attacks against an enemy fleet, with the result that the formerly much discussed *Béarn* has come to be considered the most modern and, on the whole, most powerful fighting unit under Admiral Docteur's command. It is well realized that seaplane fighting is no amateur's game, requiring, on the contrary, long and minute preparations, together with an ample reserve of adequate machines and trained men to be permanently available at the right strategic bases and ammunition depots. The additional superiority that the British navy is deriving from her supreme seaplane carrier fleet is now better understood, and regret is being expressed that France, being the country who, next to Britain, has most to defend on the water, should so long have hesitated in the adoption of seaplane carriers, the most powerful instruments of long-range offensive in existence.

Aircraft Carriers—An American Viewpoint

New York *Times* Editorial, June 15.—In effectiveness there must be little to choose between the airplane carrier *Lexington,* which has just broken speed records on a run from California to Honolulu, and her sister ship, the *Saratoga.* Each of these carriers has accommodations for seventy-six planes. British critics have said that this is putting too many eggs in one basket. Theoretically that may be so, since it is as easy to bomb a carrier as any other large ship of war. But two things would favor the *Lexington:* the great number of planes she could use to defend herself, and her high speed. Compared with the *Lexington,* our battleships are slow. Her designed speed of 34 knots could not be long kept up. In an emergency she might even exceed it. What counts most is her speed over long distances, when, for instance, she is called upon to join the fleet in a hurry. On the last twenty-four hours of her passage to Honolulu the *Lexington* steamed about 770 nautical miles—at the rate of 32 knots. The *Mauretania's* record for twenty-four hours was 678 knots. The distance covered by the *Lexington* was 2,228 nautical miles and her time for the voyage was three days, less one hour. If an enemy fleet had threatened Hawaii, planes could have been dispatched when she was still 200 miles distant, some to scout and others to attack.

While the *Lexington* and *Saratoga* are armed with eight 8-inch guns, besides guns of smaller caliber, they are expected to avoid engagement with battleships and even with cruisers. The carriers are vulnerable, their batteries are not disposed to the best advantage, and they must, if possible, avert destruction of the airplanes they are expected to send into action. Therefore high speed is requisite. When employed in picking up planes with the battle fleet steaming ahead, the carriers must manœuver without mistakes and move swiftly. There can be no doubt that other sea powers envy the United States possession of the *Lexington* and *Saratoga.* Nevertheless, we need more carriers to make up the tonnage allowed by the Washington Treaty. The additions will naturally be of smaller capacity than that of the *Lexington.*

Great Britain can build no more carriers. With completion of the *Glorious,* one of three converted "hush" or mystery cruisers planned during the war, the others being the *Furious* and the *Courageous,* the Admiralty will have all the floating airdromes it is entitled to. None of them is, or will be, as big and fast as the American pair. In the new *Akagi* and *Kaga,* Japan will have two carriers with the heaviest main armaments, ten 8-inch guns, the Washington Treaty limit. The big Japanese carriers have a displacement of 27,000 tons, but they will be slower by several miles an hour than the Americans. Japan could build one more large carrier, but the preference seems to be for small ships. That is now the case

The vast territory to be explored by Commander Richard E. Byrd and Captain George Wilkins is indicated on this map. The explorers will cover two sides of a triangle enclosing hundreds of thousands of square miles never before seen by man. Wilkins will fly northeast along a coast which is unknown between the Ross Sea and Graham Land, a stretch of more than 2,000 miles, while Byrd will fly south over the polar plateau, 10,500 feet high, and inland from the ice barrier on shorter flights.

in Washington. The United States has taken the lead in using the catapult for auxiliary planes attached to battleships and cruisers. In fact, naval aviation promises to add considerable strength to the United States battle fleet and actually put it in the lead over other sea powers.

Byrd and Wilkins

New York *Times,* June 7.—In a statement made for the American Geographical Society Dr. Bowman "sets at rest the foolish rumors that have persisted in spite of frequent denial by both Commander Byrd and Captain Wilkins to the effect that they are to race to the South Pole." Under the auspices of the society they will, as coworkers in geographical discovery and scientific research, and not as rivals, lead their expeditions to the Antarctic. The fields in which they will operate are to be far apart in the sense that, while Sir George Wilkins flies from the Ross Quadrant to Graham Land in the Weddell Quadrant, Commander Byrd, with his base at the Bay of Whales in the Ross Quadrant, will fly to the Pole and afterward explore King Edward VII Land. Almost nothing is known of the interior. Several expeditions have visited Graham Land, but it still remains a good deal of a mystery. "It is one of our most important tasks," wrote Nordenskjold in his diary when wintering there in 1902, "to find out what this so much talked of Graham Land really is, whether it is a continuous stretch of country or a group of islands and how far it goes to the southward." What Nordenskjold learned, and Charcot after him, was the existence of geological features indicating that Graham Land was probably connected with South America by a bridge under the sea. Sir Douglas Mawson has put forward this opinion:

The labors of Nordenskjold's Swedish expedition and of Charcot's French expeditions in West Antarctica have shown a relationship in rock types and in tectonic features of that region with those of the southern tip of South America.

The Swedish explorer surveyed the eastern side of Graham Land, and was compelled to winter on Snow Hill Island when his ship, the *Antarctica,* was wrecked on her voyage to take off his party. After another winter, Nordenskjold was rescued by an Argentine vessel. He did excellent scientific work, but much more remains to be done. Sir Douglas Mawson points out that "there may be quite elevated ice-capped land extending from Graham Land to King Edward VII Land and south to the Queen Maud Range seen by Amundsen." On a sledge journey Nordenskjold was prevented by an ice barrier from passing beyond the sixty-sixth parallel. In his airplane flight Sir George Wilkins should be able to map a long coast line from the Ross Sea to Graham Land and beyond. Dr. Bowman says that by photographing the ice border, glacier tongues, and the mountain ranges, the Australian explorer should find sites for the meteorological stations "he has long planned to establish." Argentina, by the way, has had a weather station on the coast of Graham Land. As the hazard Wilkins may have to deal with in finding a whaler to take him to Montevideo, it must be remembered that many ships in the course of a season visit the waters of the South Shetlands, which lie a hundred miles off Graham Land. There should be no difficulty in making an arrangement for relief with a ship captain before the flight along the coast begins.

Commander Byrd's base is fairly well known, and he has Amundsen's records to aid him in preparing for a flight to the Pole. But the interior of King Edward VII Land is a blank space of large dimensions on the map. It would be foolish to minimize the dangers of exploration in such a huge wilderness of ice and snow. Only by establishing a chain of camps as a security against disaster could the survey be undertaken. Using his airplane, Commander Byrd will have opportunities of making discoveries in Antarctica and photographing new mountain ranges and plateaus that would have been impossible to any single expedition such as Scott, Shackleton, and Amundsen led early in the century.

Battleship vs. Plane Still a Naval Puzzle

Baltimore *Sun* June 2,—By Hector C. Bywater.—The papers this week have printed stories of a new torpedo plane, known as the *Ripon* type, which gave a striking demonstration of its offensive powers before a gathering of experts at Brough, on the Humber. Armed with an 18-inch torpedo, the machine is reported to have shown

qualities of speed and handiness superior to those of any previous torpedo plane. It is intended for use in the British navy's aircraft carriers.

After reading these reports one is inclined to wonder what exactly is the attitude of the leaving admiralties toward the new torpedo menace from the air. By this time each of the big navies should have obtained enough data on which to base a very definite opinion. Britain, the United States, and Japan all possess modern capital ships, aircraft carriers and up-to-date naval aircraft. Each is, therefore, in a position to put the matter to a practical test. Yet it would be interesting to know how often and on what scale torpedo-plane attacks on a battle fleet are practiced.

Among airmen themselves here is an impression that aircraft are only rarely given an opportunity of showing what they can do against naval vessels; in other words, that the naval "brass hats" look coldly on tests which might conceivably cast doubt on the wisdom of their shipbuilding policy. If, for example, such tests revealed a high percentage of torpedo hits, then the utility of the great ship might be seriously impeached.

What the airmen desire is a series of full-scale experiments so staged as to simulate war conditions as far as possible. They suggest that the battle fleet should put to sea without announcing its destination; that two or more carriers with their destroyers and other satellites, should leave port after an agreed interval and proceed, first, to locate the fleet and then to attack it. Each side would have full liberty to make use of smoke screens and the airmen would be empowered to launch real torpedoes with "dummy" heads, thus leaving no room for dispute as to hits and misses.

This might result in the loss of some torpedoes (costing nearly £2,000—about $10,000—apiece), but the experience so gained would be well worth the price. The battle fleet would, of course, be free to send up its own planes for defense and counter attack.

The airmen profess to be absolutely confident that in such an exercise, with fifty torpedo planes at their command, they could "sink" or disable half the battle fleet at their first onslaught and that in subsequent attacks, made after they had returned to the carriers for fuel and torpedoes, the remaining capital ships would be put out of action.

They make this claim on the grounds of what has been accomplished in such limited tests as they have been permitted to carry out. Personally, having seen something of aircraft operations against a fleet at sea, I think they rather exaggerate the potency of their arm. Conversely, the battleship men may be a little too eager to disparage a weapon which they have never seen operating under conditions resembling "the real thing."

While it may be true that an eighteen-inch torpedo would be most unlikely to disable a modern battleship, it is probable that the explosion would impair, to some extent, the fighting efficiency of the vessel, and if a hit were made in line with the propellers even a *Nelson* or a *Maryland* would almost certainly be placed *hors de combat*.

But the aerial torpedoists are not banking on single hits. What they propose is to lance each leviathan with three or more torpedoes, and they claim to have worked out a scheme of coördinated tactics which would enable such a concentration to be made against individual ships in the course of a mass attack. They make light of anti-aircraft fire as a deterrent, but that may be because the antiaircraft gunners in a modern battleship have never had a chance of showing their prowess with the amazingly efficient rapid-fire guns of today.

Whether these guns would have time to get properly into action before a lightning airplane attack developed in another question. I can testify to the disconcerting suddenness with which such attacks are delivered. Some two months ago, from the deck of a battleship, I was watching the evolutions of the "Blue" (Atlantic) fleet off the coast of Morocco. We were "at war," our enemy being the "Red" (Mediterranean) fleet, and we were expecting an attack by "Red" airplanes. The weather was perfect, with maximum visibility. At one moment the sky was absolutely bare of aircraft, yet a few seconds later a flock of "Red" machines was bearing down upon us, having apparently flown right out of the eye of the sun. I don't know whether our antiaircraft gunners were caught napping, but I do know that between the first warning of an airplane attack and its delivery there is liable to be only an interval of seconds.

The problem of aircraft versus battleships is not one that lends itself to dogmatic asservation either way. But seeing that we have just completed two battleships at a cost of £8,000,000 each (approximately $40,000,000) and that a few years hence we may have to build more of these expensive monsters, it would be comforting to know that they are reasonably immune from summary destruction by a weapon which costs only about one-five hundreds the price of a battleship.

This figure, it is true, leaves out of account the maintenance and operative charges of a torpedo-plane squadron, including the provision of carriers if the machines are to function on the high seas. Even so, and as a somewhat obstinate believer in the big ship, I would welcome an assurance —founded not on theory but on practical test—that the torpedo-plane menace to the great ship has been unduly magnified.

In the meantime it is interesting to observe that certain countries which can afford only a very limited expenditure on naval defense have decided that the battleship is a worthwhile investment.

Germany, in spite of slender resources, is proposing to spend £16,000,000 (about $80,000,000) on four vessels that will be little better than glorified monitors. Under the Versailles pact she is compelled to limit all new "battleships" to 10,000 tons. Four ships of this size have been designed, and the Reichstag has voted the initial appropriation for the first vessel, which is shortly to be laid down at Wilhelmshaven.

The type will have heavy armor protection, Diesel motors for a speed about equal to that of the slower contemporary battleships, and a battery of six big guns, probably 14-inch. The Germans know as much about torpedo warfare as any nation, and in view of recent events it is pretty obvious that they are, to say the least, well abreast of current progress in aviation. This being so, the fact that they adjudge the big, heavy-gunned surface ship to be an essential component of their future fleet is highly significant.

Considerations of prestige may have influenced their decision, but with money so scarce it does not seem credible that ships costing £4,000,000 each would be built unless they were thought to be a sound investment from the viewpoint of national defense.

A further testimonial to the big ship comes from Spain, where the government has just approved a £20,000,000 ($100,000,000) naval program, including, so it is reported from Madrid, two battleships of 25,000 tons, which are to be smaller editions of the British *Nelson* and *Rodney*.

Even in France, where naval aviation has been brought to a very advanced state of development, there is a growing demand among naval men for the construction of new battleships.

It were hard to believe that this continued faith in the great ship is due entirely to the die-hard conservatism which is popularly supposed to be characteristic of the naval mind.

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NOTES ON INTERNATIONAL AFFAIRS

From June 4 to July 3

Prepared by Professor Allan Westcott, U. S. Naval Academy

ANTI-WAR TREATY SUBMITTED TO POWERS

Secretary Kellogg's Note.— On June 24, Secretary Kellogg sent to fourteen governments a revised form of his draft treaty renouncing war as an instrument of national policy. A covering note accompanied it expressing the willingness of the United States to sign the treaty "without qualifications or reservations." The text of the revised treaty differs but slightly from that originally proposed (published in the July issue of the Proceedings), the only real change being a modification of the preamble to state definitely that "any signatory power which shall hereafter seek to further its national interests by resort to war shall be denied the benefits furnished under this treaty."

The countries to whom the note was sent were Great Britain, France, Germany, Italy, Japan, Canada, the Irish Free State, Australia, New Zealand, South Africa, India, Belgium, Poland, and Czechoslovakia. Other nations will be free to join. The last favorable reply from the governments named above came from South Africa, which expressed agreement, on the definite conditions that the treaty should not impair the right of self defense, interfere with obligations under the League Covenant, or hold as regards a signatory nation violating its provisions.

In his covering note Secretary Kellogg repeated the interpretation of the treaty which he gave on April 28 before the American Society of International Law. This treated six possible difficulties: (1) Self Defense—this right in no way impaired; (2) The League Covenant—nations not obligated to use force in support of the Covenant without their own consent; (3) Treaties of Locarno—if all parties to the Locarno Treaties became parties also to the Renunciation of War Treaty, then a breach of the Locarno Treaties will also be a breach of the other, and will deprive the treaty-breaking nation of any protection under it; (4) Treaties of neutrality—allies of France will be invited to become parties to the new treaty; (5) Relations with a treaty-breaking state—as a matter of law, violation of the treaty by a member will automatically release all the other members from their obligations to the treaty-breaking state; (6) universality—preferable not to postpone the coming into force of the treaty until all the nations of the world agree.

The covering note added that all the nations to whom the treaty had first been submitted, except France, had replied without the least disapproval of the principle of the treaty, or suggestions for modification of the text. The letter closed with a request that the nations addressed reply stating whether they were willing to sign the treaty in the form presented. The revised paragraphs of the preamble now read as follows:

> Deeply sensible of their solemn duty to promote the welfare of mankind;
>
> Persuaded that the time has come when a frank renunciation of war as an instrument of national policy should be made to the end that the peaceful and friendly relations now existing between their peoples may be perpetuated;
>
> Convinced that all changes in their relations with one another should be sought only by pacific means and be the result of a peaceful and orderly process, and that any signatory Power which shall hereafter seek to promote its national interests by resort to war should be denied the benefits furnished by this treaty;
>
> Hopeful that, encouraged by their example, all the other nations of the world will join in this humane endeavor and by adhering to the present treaty as soon as it comes into force bring their peoples within the scope of its beneficent provisions, thus uniting the civilized nations of the world in a common renunciation of war as an instrument of their national policy;
>
> Have decided to conclude a treaty and for that purpose have appointed as their respective Plenipotentiaries. . . . .

GREAT BRITAIN

New Prayer Book Rejected.—On June 14, by a vote of 266 to 220 the House of Commons again rejected the revised prayer book proposed by leaders of the English Church. The new prayer book is an effort to reconcile by compromise the differences of ritual between High and Low Churchmen which have increased in recent years, and makes some concessions to the High Church party. Like most compromises, it is acceptable to neither extreme. The bill for its adoption was defeated in the commons with the aid of non-Anglicans who feared a drift of the established church toward Roman Catholicism.

ITALY AND THE BALKANS

Violence in Jugoslavia.—Fierce opposition in the Jugoslav Parliament against the government program, and especially against ratification of the Nettuna conventions with Italy, culminated on June 20 when a deputy of the government party named Ratchitch drew a pistol and fired all six rounds into the opposition group, wounding the opposition leader Stefan Raditch and killing his nephew. Four other deputies were wounded. The assassin surrendered to the police. It was believed that the tragedy ended all prospect of ratification of the agreements with Italy.

Mussolini in Pacific Mood.—In a speech before the Italian Senate on June 5, Premier Mussolini made what was described as one of his most sober and pacific addresses. Referring to naturalized Italians in the United States, he recognized that they were foreigners so far as the mother country was concerned. He expressed a desire for an understanding with France, and a sincere wish for peaceful relations with Jugoslavia.

FRANCE

Franc Fixed Near Four Cents.—On June 26 the French Chamber and Senate by large majorities approved the standardizing of the franc at exactly one-fifth its former value, or 3.93 cents, 25.52 to the dollar, and 124.1 to the pound sterling. Prewar investments in government and private securities will be repaid, on this basis, at the rate of four cents for every twenty cents put in. Five and ten franc pieces will be coined which will correspond in value to the old pieces of one and two francs. Although the Poincaré cabinet was somewhat divided over the stabilization issue, it has thus far remained unchanged since the election of last May.

GERMANY

New Cabinet.—Following the resignation of the Marx Cabinet on June 12, Hermann Mueller, leader of the German Socialists, was appointed chancellor with the task of organizing a new ministry based on a coalition of the Socialists with the Democrats, Centrists, and German and Bavarian People's parties. Dr. Stresemann remained in charge of foreign affairs. Considerable difficulty was experienced by Chancellor Mueller in building his new cabinet, but he was aided by a message on June 25 from Dr. Stresemann strongly supporting the "Big Coalition" indicated above. The cabinet was to be one of "dominant personalities" rather than of men strictly representing their parties.

Germany Can Make War Payments.—In a report on June 7 Agent General Parker Gilbert made the definite statement that there could be no question of the ability of Germany to make the required payments under the Dawes Plan for the fiscal year beginning September 1. The payment for next year amounts to 2,500,000,000 marks, an increase of 750,000,000 over this year. The agent general repeated his appeal for a final definition of Germany's total reparations liabilities by mutual agreement, "as soon as circumstances should make it possible."

LEAGUE COUNCIL SESSION

Lithuania Defies Council.—Neither a sharp scolding from Foreign Minister Chamberlain nor appeals from other council members, at the fiftieth session of the Council in the first week of June, could persuade Premier Augustin Voldemaras, of Lithuania, to speed the process of making peace with Poland. Nothing toward this end has been accomplished since the Council brought Premier Voldemaras and Marshal Pilsudski together last December and made them shake hands. Finally, and as

usual, an extension of time was granted for the two nations to come to terms. In his remarks to the Lithuanian Premier, Foreign Minister Chamberlain chided him for trading on the sympathies of the major powers, and called upon him not to throw that sympathy away. He declared the naming of Vilna as the capital of Lithuania, in the new Constitution, "an act of ill will and provocation."

OTHER WORK OF COUNCIL.—At the fiftieth session of the Council the long standing dispute between Hungary and Rumania over land in Rumania taken from Hungarian owners was at last removed from the Council calendar. No settlement was reached, but the Council contented itself with a final recommendation that the two countries come to an agreement along lines suggested by the council.

The Council also went ahead with plans for an independent League of Nations radio station at Geneva, to insure immediate notice of ruptures anywhere in Europe.

UNITED STATES AND LATIN AMERICA

ARBITRATION CONFERENCE CALLED.—Following out a resolution adopted at the Havana Conference last February, Secretary Kellogg on June 20 issued a call for a conference of delegates from the twenty-one American republics to meet in Washington on December 10 for the purpose of drawing up a convention for obligatory arbitration of their international differences of a juridical character. Each nation was asked to send two delegates with the usual staff of experts. Secretary Kellogg and ex-Secretary Hughes were named as the United States representatives.

The resolution of the Havana Conference under which the present conference is called is the one containing the now familiar clause, "Whereas the American republics desire to express that they condemn war as an instrument of national policy in their mutual relations. . . . ."

FAR EAST

SON SUCCEEDS CHANG TSO-LIN.—Although not officially announced until June 21, it became definitely known considerably earlier that Chang Tso-lin, long-time dictator of Manchuria and leader of the Northern opposition to the Nationalists, had been killed when his train was wrecked by a bomb on June 4 as it crossed a bridge near Mukden. Responsibility for the bombing was not fixed, but Chinese leaders in Manchuria were inclined to accuse the Japanese of connivance, since the railway line was guarded by Japanese troops. General Chang Hsueh-liang, son of Chang Tso-lin and a capable youth of twenty-seven years, on June 19 assumed his father's powers as governor of Fengtien and Manchurian dictator. The Japanese accepted this arrangement, although it was believed that they were dissatisfied over their relations with the elder Chang, and would hesitate to shift their support to his son, especially if he should fail to come to terms with the southern Nationalists.

In his statement of policy Chang declared that he would welcome foreign capital in Manchuria, but foreign corporations must agree on half Chinese control. His aims included abolition of unequal treaties and negotiations with the Nationalists for a peaceful settlement.

JAPANESE POLICY.—In view of improved conditions in the Yangste Valley the Japanese Government on June 21 ordered the withdrawal of twenty-seven destroyers and two cruisers sent there in May. Other signs indicated that the Nanking and Tokio Governments were inclined to come to amicable terms, and that, for the present at least, as Foreign Minister Wang stated, Nanking would recognize the special position of Japan in Manchuria.

The Tokio Foreign Office in June took pains to deny a widespread report that Tsingtan and Tsinan-fu were to be placed under foreign administration like Shanghai. The fact remained, however, that Japanese military occupation of these cities and the railway line between had placed them for the time being outside Nationalist control, and freed them from the burdensome taxation imposed elsewhere. Abolition of nine classes of illegal taxes was announced at Tsingtau on May 30 by the government organized there by the Chinese Chamber of Commerce.

As for Manchuria, Vice-President Matsuka of the Southern Manchuria railway, in an interview published in the New York

Times of June 17, said, "Call it a protectorate if you like, there must be peace in Manchuria at any cost and Japan will fight to prevent Southern military operations in the province." Manchuria, he added, was Japan's first line of defense.

PEKING HELD BY NATIONALISTS.—After having been occupied for several days by only a small protectionary force of 1,200 Northern troops, Peking was quietly taken over by the Nationalists on June 8. According to arrangements made among themselves by the Nationalist leaders, the entering troops were from Shansi province under the "model governor," Yen Hsi-shan, who was appointed Defense Commissioner of Peking and entered the city on June 11.

At the request of the foreign diplomatic corps at Peking, the protectionary troops were given a safe conduct through the Nationalist lines, but through some misunderstanding they were halted after their departure from Peking by troops of Feng Yu-hsiang, forced to return to Peking, and there disarmed. This occasioned a protest from the dean of the Peking diplomats, and apologies from Nanking.

It was generally believed that the Nationalists would favor shifting the capital from Peking to Nanking and early in June there were reports of the transfer of the Directorate of Posts and the Salt Administration to the southern capital.

CLASH OVER TIENTSIN.—Tientsin fell peacefully under control of the Nationalists on June 12, the evacuation of Northerners and entry of Southern troops being effected without disorder, while by mutual agreement 3,000 Shansi men out of uniform policed the city. On the night of June 13, however, there was a good deal of disorder and looting in the native city, and on June 14 there was a fight between the Shansi police and a band of 400 Northerners who broke loose in the central railway station. Order was restored on June 15 upon the arrival of 10,000 reinforcements from Peking.

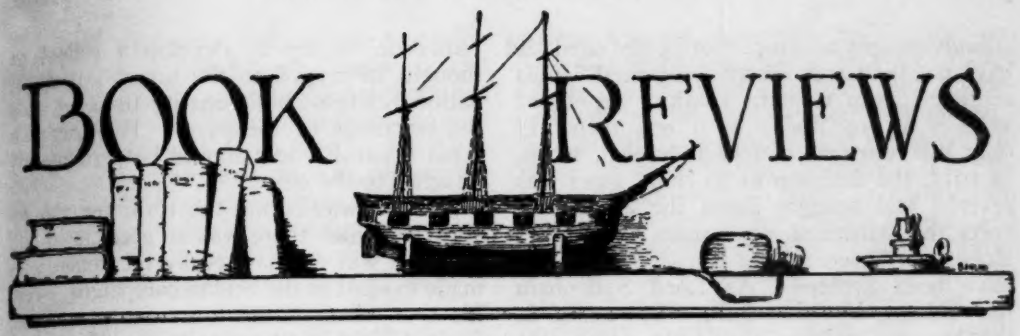
DEMAND EXIT OF FOREIGN TROOPS.—On June 11, it was announced by the Nanking official news agency that the Nanking Government had prepared a manifesto calling upon all the treaty powers to withdraw their military forces from Chinese territory, on the ground that fighting was over, the reconstruction period begun, and that its effective carrying out required not only the removal of foreign troops but the revision of treaties. Similar requests were made in a note to United States Minister MacMurray, made public June 6.

Declaring the military phase of the revolution ended, and his services no longer needed, General Chang Kai-shek, Chairman of the Nationalist Military Council and leader of the Southern forces, resigned from his military duties on June 10. Rumors at the time attributed his withdrawal to difficulties with General Feng Yu-hsiang, who was believed to be gaining ascendancy in Nationalist Councils. Dr. C. T. Wang, who took control of Foreign Affairs on June 11, was spoken of as Feng's appointee.

AN ASIATIC CORDON.—The following explanation of present Soviet policy in Asia appeared in a dispatch from Walter Duranty to the New York *Times* of June 22:

> At last there has come forth an explanation of the motives underlying the Afghan King's journey in relation to the Soviet Union and the two other "Eastern limit ropes," Persia and Turkey. An editorial in *Isvestia*, organ of the Soviet Government, reveals the secret (perhaps more openly than was intended) in a couple of phrases.
>
> The Soviet has succeeded, says the writer, in establishing a vertical line of connection between it and each of these three States, and now has supplemented that by a horizontal line linking the three States together with a network of guarantee compacts, non-aggression treaties, and coöperation treaties. During Amanullah's visit to Moscow, while the British press was filled with rumors about an alleged Soviet project for a Russo-Afghan treaty of alliance, dispatches to the New York *Times* emphasized that the real Soviet desire was first to coördinate the interrelations of Russia's three smaller neighbors, and then regulate relations with them on a uniform basis. Bilateral treaties just signed at Teheran and Angora with the Afghans show that the first stage of this far-sighted policy has been accomplished. As the matter now stands the Soviet has lined up three countries which form a buffer between British and Russian possessions on the one hand and a barrier between the British Mediterranean and India on the other into a new Asiatic bloc, which is the basis of Tchitcherin's policy under the slogan "Asia for the Asiatics."
>
> That policy, it must be remembered, had a startling success in China until vitiated by the ignorant and hot-headed meddling of the Third International, which, as often has been stated, had no connection with the Soviet Government.

BOOK REVIEWS



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MY WORKING LIFE. By Colonel Lord Sydenham of Combe. John Murray, London.

REVIEWED BY CAPTAIN THOMAS G. FROTHINGHAM, *U.S.R.*

This book is well named, for it is the record of a life spent in working for the British Empire—a "working life" wholeheartedly devoted to the best developments of Britain's world wide interests. The book covers the eventful epochs of history from the seventies until the present day, and any officer who reads this straightforward narrative of service will get a better idea of what the British Empire means to the world than can be found in the volumes of many libraries.

The author is best known in the United States as Colonel George Sydenham Clarke, and his books and articles have won wide recognition in this country. He was given his peerage as Lord Sydenham for his many distinguished services to Great Britain, especially in regard to the Imperial dominions.

Lord Sydenham's first sentence will appeal to Americans: "I was born on Independence Day in the revolutionary year 1848, and it has several times happened to me to join Americans in celebrating their great anniversary." His choice for a profession was Woolwich and the Royal Engineers. He was first of his class, and his standing made him suitable for a position offered to "a young R.E. officer to teach practical geometry and engineering drawing at the new college at Coopers Hill, to meet the requirements of the Indian Public Works Department." This assignment, in 1871, occupied the years when he was a subaltern, and, as Lord Sydenham expresses it, "an apparent accident changed everything." This is a statement of fact, because these nine years gave him an opportunity for scientific study and original research at the very time when the usual life of an officer in the British Army was a matter of formal routine, as the years following the Franco-Prussian War were very unprogressive in the services.

But, instead of falling into the conventionalized ruts, this young officer, who was commissioned Captain Clarke in 1880, had already made his mark in his profession, and his writings had shown that he was qualified to be a technical expert. Consequently, in 1882, he was ordered to Alexandria "to make a detailed report on the defenses, and the effect of the fire of the fleet upon them. Thus, at the age of thirty-four my first independent public task came to me, as a result of the impression produced by my study of Plevna upon Major General Sir Andrew Clarke, lately appointed Inspector-General of Fortifications." This important duty Captain Clarke performed in a way that was far ahead of his times.

He cut loose from commonly accepted ideas, and brought in a report which was adverse to ships' guns when used in bombardment against guns on land. "The next ten years will doubtless see a considerable development of the power of ships' guns; but the offensive strength of coast works will advance *pari passu*, and the ships themselves will continue to labor under certain

disadvantages which cannot be obviated and have not been sufficiently recognized." This sentence from Captain Clarke's report of 1882 is as true today as it was then. If only this warning had been heeded, when, in 1915, the delusion as to ships' guns was revived and brought about the attempt to force the Dardanelles by means of the fleet alone, the fiasco at the Dardanelles would have been avoided. As Lord Sydenham has written, in this regard, "The moral is that the successful conduct of war may turn upon the mastery by its directors of the lessons of the past."

This Alexandria report had put Captain Clarke in touch with the Navy as well as the Army, and from this time on his studies were of value to both services. It will be interesting to officers of the United States Navy to note that, while making his investigations at Alexandria, Captain Clarke met the late Rear Admiral Caspar F. Goodrich, then Commander Goodrich, who was on a similar mission for the United States Navy. Captain Clarke gave Commander Goodrich all the help in his power, and this was the beginning of a life-long friendship. After finishing his work at Alexandria, Captain Clarke studied the Tel-el-Kebir campaign. His comment showed his progressive trend of mind: "To me the time spent in Egypt was a period of intensive education. Professionally it proved invaluable, not only on the technical side, but as a revelation of some of our military defects which I tried to follow up in later years." In 1883 Captain Clarke joined the fortification branch of the office of inspector-general of fortifications.

He has written his disapproval of the atrophy in the services at this time. "In artillery progress, owing to our obstinate rejection of breech-loading, we were rapidly falling behind the times. Worst of all, the strength of the Navy had been allowed to decline to a dangerous extent, and a great effort to enlighten the public was necessary in order to bring about the Naval Defense Act of 1889, by which the fleet was at length restored to the standard subsequently maintained and was able to prove the salvation of the Empire in 1914-1918. . . . . I brought to my new post some strong convictions with regard to the Empire, the Navy, fixed defenses and their mutual relations." Captain Clarke was convinced that in Great Britain "Fortification had become highly conventionalized," and it was his "ambition to try to develop a school of thought in regard to the broad aspects of national defense and security founded upon the teachings of the past." He saw to it "that a naval officer should be permanently attached to the office."

All this was laying the train for the reform of which there was so great need and the need was emphasized by the deficiencies made evident in the Sudan campaigns. From his own observations of these operations, Lord Sydenham has written: "I reached some strong conclusions as to the defects of our staff system, which stood openly revealed in the Boer War and were not remedied till 1904." And he devoted every possible energy to a long uphill fight for reform. In 1885 he became secretary to the colonial defense committee, of which he has stated: "It was a small beginning of Imperial organization." In 1888 he was secretary of a royal commission to inquire into the administration of the naval and military departments. Of the work of this commission he has written: "If the recommendations of this strong commission had been carried out, the course of the South African War nine years later would have been very different. Influences which I never fathomed prevented anything from being done."

In this period, Major Clarke was given many missions abroad to study fortification and ordnance. In 1888 he came to the United States to report upon the Zalinski pneumatic gun. In 1890 he was asked by the King of Belgium to make "an independent report" on the new Brialmont fortifications of the Meuse, and he "made a detailed examination of the positions of Liege, Namur, and Antwerp." His unfavorable report was "resented by General Brialmont," but Lord Sydenham has every right to say that it "proved strangely prophetic," as these defenses were useless in 1914. At this stage, he also did a great deal of writing, both on technical subjects and in urging his reforms. In 1890 he published the first edition of his book, *Fortification, Past, Present, and Future,* which is a work highly valued in this country.

Hostility in the War Office toward the colonial defense committee brought about the dismissal of Major Clarke from the committee, and he was ordered to Malta in 1892. This was a depressing setback for his cherished aims. But, in 1894, he was

appointed superintendent of the gun carriage ordnance factories at Woolwich, and this gave him the opportunity to carry out changes in gun mountings, to do away with the "too cumbrous" types then in use. But the South African War made so evident the defects of British organization, that at last the way was made clear for the reform.

The chief evil had been the mistaken policy of centralizing the powers of the War Office in the commander-in-chief. This had grown out of all bounds under the régime of Lord Wolseley. As Lord Sydenham has expressed it, "Centralization at the War Office had now reached its zenith, and there was nothing comparable to it in any other system. . . . . The War Office had become an enormous bottle with a narrow neck represented by the Adjutant-General and the Commander-in-Chief." In 1901 Colonel Clarke became a member of the "War Office Reorganization Committee," and the committee brought in a strong report. (May, 1901.) This made a marked impression, but the time was not yet ripe for an overturn of the system which had taken such deep root. As Lord Sydenham has stated, "Some few of our recommendations were accepted, but needed to be reasserted and developed in 1904, when the powerful leverage of the Elgin Commission could be turned to account."

After completing his work on this committee, Colonel Clarke received well deserved recognition for his services in colonial affairs, as he was made governor of Victoria. This gave him important duties in Australia at the eventful time "when the Commonwealth was beginning to get into its stride." His account of Australia is most interesting, and it is evident that his ideas of an Imperial Federation were prophetic. Colonel Clarke was called back suddenly from Australia in November, 1903, by a summons which meant the fruition of his long years of efforts for reform in the War Office. Lord Esther, Admiral Fisher, and Colonel Clarke were made a committee of three "to advise on the reorganization of the War Office."

Lord Sydenham's accounts of his labors in the ensuing years are worthy of study—efforts to bring about "a Council of Imperial Defense, the creation of a real General Staff, and drastic decentralization." This part of the book is an important contribution in the history of the Empire—political, military, and naval. In 1907 Colonel Clarke was to be sent to India with a commission "on the decentralization question," but, instead, was appointed to the important office of governor of Bombay. The account of his work in India is another instructive picture of the British Empire and its dominions over the seas. Colonel Clarke was in hearty sympathy with the Native States, but he was strongly against the revolutionary movements which were already doing harm.

The subsequent events in India have proved that he was right in this opposition, and Lord Sydenham is justified in his claim: "History records nothing which can approach the British achievements in India, and the world will never see the like again. *Si Monumentum quaeris circumspice.* Turkey, China, Persia and Afghanistan give some idea of the position in which India would have stood today, but for what Mr. Gandhi regards as 'the Satanic Government.'"

Upon his return to Great Britain in 1913, Lord Sydenham was given his peerage. This was the end of his active government service of forty-five years—but by no means the end of his "working life" for the British Empire. As he has stated, "the world was hastening towards its greatest tragedy, and in England there were few warning voices." In the World War period, Lord Sydenham remained indefatigable in his efforts for his country. In the House of Lords, in the press and other publications, in organizations and commissions, his is a record of help for all means of carrying the war to a successful aim, and of combat against the illusions which were stumbling blocks in the path.

He had always opposed the "invasion scare" which was so constant a detriment to Great Britain throughout the World War, by keeping uselessly in Great Britain, "for home defense," great numbers of troops which were needed on the battlefield. He early saw the harm done by the failure to shut off supplies from enemy countries, and he was a strong advocate of the precedents of blockade established in the Civil War. Eventually, it was only by applying these principles that an effective blockade was established, after long and costly delays. He was also quick to detect the malign influ-

ences at work under the surface to weaken his nation.

Since the war, he has kept up his fight against the propaganda of these same hostile elements, now working under the guise of revolutionary socialism. And his last chapters are warnings against the dangers of their encroachments. Lord Sydenham's "working life" has been devoted to building up the British Empire and its defenses, His career preaches this text, and his example, his experience, and his warnings will undoubtedly have an effect upon those who stand for the British Empire.

LINE OF POSITION BOOK. By Lieutenant Commander P. V. H. Weems, U. S. Naval Institute. $2.50, also separate Diagram $.80.

The *Line of Position Book* by Lieutenant Commander Weems, published by the U. S. Naval Institute, is a most excellent example of what may be accomplished in the reduction in size of navigational tables. This little volume of only forty-four six by ten inch pages contains all that is necessary, except the data in the *Nautical Almanac*, for the determination of celestial lines of position at sea or in the air.

The method of computation employed is remarkable for its simplicity, the only calculations required for obtaining the calculated altitude being one arithmetical and two algebraic additions entirely free of interpolations. The azimuth is obtained easily and accurately by means of a diagram occupying only four pages of the book.

Computation of the line of position is extremely rapid. After calculation of the local hour angle (which is common to all methods), the reviewer has been able to average a calculated and plotted line in less than two minutes, and this with very little practice. The newcomer to the book may be disagreeably surprised at first noting the apparent length of the calculations shown in the illustrative problems given, but it should be remembered that more than two-thirds of this space is devoted to calculation of the local hour angle and to the application of the necessary corrections to the observed altitude. It is unfortunate that Commander Weems failed to include at least one problem illustrating the short methods of calculating the hour angle and of reducing the altitude which are permissible to the aërial navigator, for the advantages of his method would then be more apparent.

Unlike most short navigational methods this one does not sacrifice accuracy. The method does lose accuracy somewhat when the observed body is near the horizon or the zenith but as these are cases which the navigator naturally avoids because of the difficulty of getting good sextant readings, it does not militate against the method.

To the best of the reviewer's knowledge Commander Weems's book is the first which takes definite cognizance of the needs of the aërial navigator. The tables for the reduction of the observed altitude include special columns for the correction of bubble sextant sights. These columns are applicable to sights taken with such sextants as the Bureau of Standards (U. S. Navy), Willson Octant, or Noel Davis sextant, which instruments give altitudes of the sun's center. The book also gives the height of eye correction for altitudes to one thousand feet and is, therefore, of use to an aviator who is using an ordinary sextant on the sea horizon. An "Aviator's Speed-Time-Distance Table" and a "Course Correction Table," which latter gives the angle of drift for various wind directions and forces, are also included for use in aërial dead reckoning.

The book is in no sense a textbook on navigation. It presupposes a knowledge of the elements of the science of navigation and contains only enough explanation to illustrate the particular method used. The author has kept very close to his subject, the line of position of the practical navigator, and has omitted all tables or arrangements which partake more of the nature of astronomy, surveying or mathematical acrobatics. For these reasons one who is properly based in navigation will appreciate the compactness, directness, and simplicity of Commander Weems's work.

In view of the increasing use of the bubble sextant in aërial navigation and of the natural desire of the ship's navigator to do his day's work with as little mental wear and tear as is necessary, the *Line of Position Book* is recommended to both seamen and aviators. It deserves to be popular.

M.F.S.

AN AMERICAN SOLDIER AND DIPLOMAT—HORACE PORTER.

By Elsie Porter Mende in collaboration with Henry Greenleaf Pearson, Frederick A. Stokes Co., 443 Fourth Avenue, New York, Price $5.00.

This summary of the life of General Horace Porter, published in September, 1927, cannot fail to be of interest to every naval officer and citizen. It has been compiled by his daughter, Elsie Porter Mende, who, after his death, presented the Naval Academy with General Porter's portrait which now hangs in Memorial Hall.

General Porter, throughout his fourscore years, was a soldier, business man, representative citizen, writer, orator and diplomat. He was born in Pennsylvania, April 15, 1837, and prepared for college at Lawrenceville. He was recommended for appointment to West Point by the then Secretary of War, Jefferson Davis. His was a notable career at West Point. Besides being honored by the position of adjutant of the corps, he graduated number three in his class. During the Civil War which followed, he distinguished himself at the Battle of Chickamauga for which he received the medal of honor. Following this, he later became aide on the staff of General Grant. At this time General Grant wrote a letter to General Halleck as follows:

> Captain Horace Porter, who is now being relieved as chief ordnance officer in the Department of the Cumberland, is represented by all officers who know him as one of the most meritorious and valuable young officers in the service. So far as I have heard from general officers there is a universal desire to see him promoted to the rank of brigadier-general and retained here. I feel no hesitation in joining in the recommendation, and ask that he may be assigned for duty with me. I feel the necessity for just such an officer as Captain Porter is described to be, at headquarters, and, if permitted, will retain him with me if assigned here for duty. I am, etc.

His experience with Generals Grant and Meade was most varied and he had the opportunity of observing the work of the leaders on both the Union and Confederate sides during the memorable campaigns of 1864. His close association with General Grant made it possible for him to later write his book *Campaigning With Grant*. After the war, as a colonel, he was stationed in the War Department and later became secretary to President Grant. In his close friendship and loyalty to President Grant, General Porter was a powerful figure at the White House. It gave him experience in big affairs—national and international—which was invaluable to him in later years. And during the last sad days of General Grant's life—with his health and fortune gone—no truer friend remained than General Porter. He alone is responsible for the drive which was successfully made to obtain funds for building the monument to Grant on Riverside Drive, New York.

In the nineties General Porter became one of the most prominent citizens of New York City. As president of the Union League Club and as one of the best known after-dinner speakers in America, no occasion or dinner was complete without him. His addresses made at the dedication of the Washington Arch in 1894, at Grant's Tomb in 1897, and the Centennial address at West Point in 1902 were especially notable—the latter of which in the appendix is well worth reading. The story of his ambassadorship in France, coming as it did on the eve of the Spanish-American War, and his efforts which brought about the finding of the body of our naval hero, John Paul Jones, form interesting chapters.

During President Roosevelt's administration, General Porter took an active interest in the Navy, becoming president of the Navy League in 1909 when he witnessed the return of the Atlantic fleet from its cruise around the world. In fact, from 1906 until the time of his death, it seems that he was fighting for a bigger Navy and promoting this spirit throughout the country. He was instrumental in obtaining the appropriation for the tomb of John Paul Jones at Annapolis, and, following this, became a delegate to the second peace conference at The Hague in 1907. With the Navy League, even though advanced in years, he took an active part in urging the huge naval program in 1915 before America entered the World War.

The story of his life is one which sets a high standard for the men of today to follow. It was one of service to his fellow citizens and his country. Imbued with the spirit of West Point and with a splendid background of military and diplomatic training, he was one of those outstanding officers, citizens and diplomats who lived to make the United States a greater nation. As he approached the end in 1921, and reflected upon

the honors which had come to him during his active eighty-four years, he said, "But all that doesn't count for so much in the long run. What really counts is to be at peace with one's self. A clear conscience is what is most conducive to sound sleep. I'm sitting here waiting for taps, and when it is sounded they'll find me ready."

W.R.V.

EVERY DAY LIFE IN THE NAVY. Autobiography of Rear Admiral Albert S. Barker, Richard G. Badger. Boston. $5.00.

REVIEWED BY CAPTAIN DUDLEY W. KNOX, *U. S. Navy (Retired)*

This autobiography, covering a period from 1859 to 1905, teems with incidents taken from the Admiral's diary and gives an unusually clear insight into a phase of naval history which should prove of great interest to the generation of today.

Admiral Barker began a very active career in 1861, when, after graduation from the Naval Academy, he joined the U.S.S. *Mississippi* and took part in the early blockade of Confederate Gulf ports. As one of the largest of Farragut's squadron she was conspicuous in the passage up the Mississippi River past Forts Jackson and St. Philip, the capture of New Orleans and the first run past Port Hudson. During the latter operation the *Mississippi* grounded close to Confederate batteries and had to be abandoned, after being set on fire by the executive officer, Lieutenant Dewey. Barker continued active river service in the *Monongahela* until the summer of 1863 when he went north to recuperate his health. From 1864 to 1867 he served in the Pacific on board the *Lancaster*, which was present at the bombardment of Callao by the Spanish fleet.

While in command of the *Enterprise* Barker made a notable cruise around the world (1882-86) in which almost every variety of naval experience was encountered. Scientific data were collected for the Navy and the Smithsonian Institution, and include a globe encircling line of deep-sea soundings. At Madagascar the murder of an American citizen was investigated for the State Department, which also had requested reports on consuls at Zanzibar and other places. In the Straits of Sunda "we were passing through large quantities of drifting pumice stone and floating uprooted trees and other débris, with occasionally dead bodies of men and animals. . . . . Some blocks of pumice were larger than a bushel basket." Meeting a Dutch man-of-war Barker was informed of the "appalling eruption of Krakatoa, accompanied by an earthquake and tidal wave . . . . the Bezee Channel had been blocked up . . . . the town of Angier had been utterly destroyed and there was so much pumice stone in the water that vessels could not communicate with the shore." The *Enterprise* remained in this vicinity several weeks rendering such assistance as was possible.

After a winter in Korea, the *Enterprise* went to China and was present at the Pagoda Anchorage when the French fleet bombarded the Chinese forts and ships at that place.

> Within less than five minutes from the time the first gun was fired the Chinese flagship . . . . was blown up and sunk by a French torpedo boat. We saw a high column of water with smoke envelop the vessel which staggered, careened, and slowly went to the bottom. It was a sad sight, but it showed the destructive force of the torpedo. . . . . Another Chinese vessel, the one nearest to the *Enterprise*, was sunk by a shell. In a comparatively few minutes after the fire became general there was a dense cloud of smoke over the river and arsenal, shutting them from sight, but we could hear the rattling of machine guns, the bursting of shell and the discharge of cannon. . . . . The havoc was terrible. Hundreds upon hundreds (of Chinese) jumped into the river to escape from the burning vessels. . . . . They took their chances of being drowned, where the current was strong and the water muddy.

On the return to the United States the *Enterprise* ran a "farthest south" line of soundings between New Zealand and Magellan Strait.

In 1894, while in command of the *Philadelphia*, Barker spent several very stirring months in Honolulu during the critical period preliminary to the formation of a republic, while a Royalist revolution, encouraged by European influence, was imminent. Early in 1898, during the period of strained relations with Spain, and for some time after the outbreak of war, he was a member of the war board which advised the President and the Secretary of the Navy upon naval policy and strategy. In May he took command of the cruiser *Newark*, and was present at the bombardment of Santiago by the American fleet.

After the Spanish-American War Barker succeeded to the command of the *Oregon* and took her, together with several other vessels, to Manila, where he relieved Dewey in command of American naval forces on the Asiatic Station. This duty was followed by a tour as commandant of the New York navy yard, during which he gained eminence as a speaker at many functions in the metropolis.

Admiral Barker's administration as commander-in-chief of the North Atlantic fleet (1903-05) was notable for extensive maneuvers and exercises which brought the fleet to a very high state of efficiency.

The book often deals in events of more than ordinary importance and gains force from its simple and unbiased style. It was prepared by the Admiral in the belief that the public interests would benefit from a wider and more accurate knowledge of the *Everyday Life in the Navy*. Throughout its pages there is unconsciously recorded inspiring evidence of a splendid personality, of a fine Christian officer and gentleman who has more than done his part to make the Navy what it was and what it is today.

FROM CARRACK TO CLIPPER, A BOOK OF SAILING SHIP MODELS

By Frank C. Bowen, 1927. $5. London: Halton and Truscott Smith, Ltd. New York: Minton, Balch and Company.

The current popular interest in old sailing ships and sailing ship models is undoubtedly responsible for the writing and publication of the book, *From Carrack to Clipper*, by Frank C. Bowen, author of *The Golden Age of Sail*, and *The Sea: Its History and Romance*. The book will make a worthy addition to the library of the sailing ship enthusiasts, many of whom can be found in the naval service, as it is perhaps the first really valuable book on the subject to be offered at a reasonable price. The introductory chapter states that "Two or three expensive books on the subject have been published. . . . . But there are many model enthusiasts who cannot afford to pay such prices either on their hobby itself or on books about it." There have also been many low priced books on the subject which are disappointing because of their lack of photographs, and their hasty sketches. *From Carrack to Clipper* compares favorably with the expensive volumes, and does the subject justice at a price which almost any interested person can afford.

The size of the book is six by nine inches, printed in large, clear type on stout paper, bound in dark blue stamped with gold. The frontispiece and three other full page plates are in colors. The text comprises the first sixty-two pages and is well interspersed with detail sketches. Among the chapter headings are: Early Types, Carracks and Caravels, The Development of Sail Plan, Improved Masting, Guns and Gunnery, Merchantmen and Men of War, Decoration, Canvas, Spars, Rigging, Speed, Comparative Design. Each subject is dealt with in a concise and interesting description.

Following the text are sixty-seven full page half-tone plates of historic and other ship models, which are a pleasure to study. They represent ships of all types within the period covered by the title of the book. Historic ships in the series include the *Santa Maria*, the *Half Moon*, the *Hollandia* (de Ruyter's flagship), H.M.S. *Victory*, the Marblehead schooner *Rebecca*, and the *America*. There are also other American, English, French, Dutch, Swedish, Norwegian, Danish, and Spanish ships. The clear cut, close-up photographs could not be improved upon.

The last few pages of the book are devoted to a list of museums containing ship models. There are forty-five such institutions listed by countries, the American section including a paragraph concerning the Navy's own museum at the Naval Academy.

The writer feels that the only shortcoming of the author is his failure to include a model of "Old Ironsides," but he also believes that any lover of ship models will derive a very keen pleasure from the possession of the book.

A. R. McC.

COMMAND AND DISCIPLINE.

By Vice-Admiral Sir Herbert W. Richmond, K.C.B., Commandant of the Imperial Defence College, London. Edward Stanford, Ltd. 186 pp.

Here is a book that one can conveniently slip into one's pocket, and beguile a train journey of four or five hours. This is true not only because of size, but because the reading will engender reflection of a type to which gazing out of car windows seems the fitting accompaniment. Briefly it con-

sists solely of quotations from military and naval writers of various periods arranged by chapters under the two general heads of "Command" and of "Discipline." The extracts are of two sorts: those that call for some pondering; and others that may be passed over lightly but which are not without value as salting the whole.

The author is well known for his distinguished success in his profession. He has recently become commandant of the Imperial Defense College where his task is to guide officers from the three armed forces of the British Commonwealth in reaching a common doctrine for the conduct of war.

In reviewing a book of this sort there is always the temptation to quote too much, especially where most of the quotations are refreshingly unhackneyed. The true task of the reviewer is where he believes the work of value, to quote enough to whet the appetite of the reader. This balance is the measure of his success. It is unusual to find Shakespeare present in connection with command, but considering the universality of his genius it is not surprising.

> They call this bed-work, mappery, closet-war,
> So that the ram that batters down the wall,
> For the great swing and rudeness of his poise,
> They place before his hand that made the engine:
> Or those that with the fineness of their souls
> By reason guide his execution.
> (*Troilus and Cressida.* Act I, Sc. 3.)

This quotation read in the next breath with such a modern as Baudry, "La Bataille Navale," shows how ever present is the problem of materialism. "The good specialist officer tends too easily to acquire a particular, if not a particularist, point of view. The good mechanic becomes only too often the attentive servant of his instrument. In order to *command*, the spirit of analysis and attention to minutiæ must be replaced by one of a synthetic and broad type."

The subject of discipline is treated as well historically as otherwise. Our forbears were not perplexed with the arguments of the behaviorist school of pyschology. They shrewdly attained their goal by the two avenues of the hope of reward and the fear of punishment. "But the Boyes The Boatswaine is to see every Munday at the chest to say their compasse, and receive their punishment for all their offences, which done, they are to have a quarter can of beere, and a basket of bread, but if the Boatswaine eat or drink before hee catch them, they are free." (Captain John Smith, *The Seaman's Grammar*, 1627.) In turning the boatswain out early, the sly appeal to any dormant tendency to cruelty, is not overlooked.

> Let us sink as far as possible the respective titles of officers, sergeants and privates, merging them into the one great cognomen of soldier, causing all ranks to feel that it is a noble title, of which the general as well as the private may be proud. Let us give up the phrase "officer and gentleman," substituting that of "soldier" for it; let the word officer be used as seldom as possible, so that the private may really feel that there is no gulf between him and his commander, but that they are merely separated by a ladder the rungs of which all can equally aspire to mount.

This is not an extract from the field regulations of the Red Army but a quotation from that eminent Victorian soldier, Lord Wolseley. Here is food for thought. The difficulty is to find the all embracing word. Seaman is not enough. "He must be that, of course, but also a great deal more." The two aspects of our being, that of seaman and military man, must be combined. Navalman occurs to mind, but the term is awkward. What is wanted is one that rolls easily from the tongue.

The book is recommended to those who would start chains of thought on the all important subjects of command and discipline. In short, it is an excellent breviary for the naval profession. E. G. S.

BLACK DEMOCRACY—The Story of Haiti. By H. P. Davis. 369 pp. New York. Lincoln MacVeagh. The Dial Press. $5.00.

Reviewed by Brigadier General George Richards, *U. S. Marine Corps*

This comprehensive history of the Haitian people is the work of a disinterested student of all phases of America's problem in Haiti. Its appearance, as a publication, has been anxiously looked for, especially by those familiar with the more recent history of the so-called Republic of Haiti and interested in the success of our government's efforts to establish conditions offering reasonable assurance that the people of Haiti will be able to maintain a stable self-government. The author possesses a rare equipment for the task he undertakes. In his twelve years of residence in Haiti he alike enjoyed the confidence of the leaders

of the people of Haiti and the American officials responsible for the discharge of our treaty obligations. The author has performed a distinctive public service in placing his work before the American reader, and it is to be sincerely hoped by all true American patriots that it will leave its impress upon public opinion of today. The author has no political axe to grind.

Fully one-half of his volume is devoted to an exposé of the immediate causes of the American intervention, with its later history, including its achievements and its failures. Preceding this, however, and as the background of the picture he draws of present day complications, the author traces chronologically the history of Haiti and its people from its very beginnings—the days of its discovery by Columbus in 1492. That story of Haiti roughly divides itself into at least six periods: (1) the aboriginal or pre-Columbus period; (2) the Spanish settlement following the discovery; (3) the period of French colonization and development; (4) the period of internal strife ending in slave emancipation; (5) the inauguration and history of the so-called Black Republic; and finally (6) the American intervention. The studies of each of these phases are models of fine condensation. The basic, important facts are there, and in consequence the book as a whole provides opportunity to survey the entire field under consideration. Especially valuable is the author's vivid narrative of that turbulent history of Haiti during the seven years preceding the intervention. These tragic events of that era seem to be forgotten by the American public of today. That period Mr. Davis terms the "Period of Ephemeral Governments;" an era punctuated by recurrent insurrections, revolutions, assassinations, and otherwise distinguished by a most extraordinary series of bond issues and financial operations. These brought the Republic of Haiti into political, moral, and financial bankruptcy. These events, over which the United States not only had no control, but which it did its best to avert, compelled us under the shadow of European complications to occupy Haiti single-handed. Our immediate responsibility then was to undertake the restoration of stable government. But the United States, as the author clearly shows, cannot honorably withdraw from the task events so imposed upon us, until the administration of Haitian affairs has been so reconstructed as to afford bases, or satisfactory guarantees, not for the maintenance of internal peace alone, but more particularly for the judicious development by the people of Haiti of the correct principles of self-government.

Politically, since the independence of 1804, free Haiti failed, for itself and for its people, to establish or develop any cohesive political system. The rulers of the country were with few exceptions military despots. Constitutions without number, embodying varying principles, were adopted as new rulers appeared. Democracy, the rule of an intelligent, articulate electorate, born of the masses of Haiti, was unknown. Around those despots there grew up a group of the more intelligent, the élite, as Mr. Davis calls them, not at any time more than 2,000 in number, who represent not only public opinion in Haiti, but are in fact the rulers of the inarticulate. Haiti is not a democracy; it is an oligarchy. The author gives to the American reader a fair idea of the absolute rule this privileged class exercises over their ignorant and politically powerless fellow-countrymen. That long system of forced dependence on the caprice of those in power has produced in these masses of Haiti a mental condition the average American cannot grasp. A long enslaved people, it has been truly said, instinctively craves the strong hand of the master. And Lord Dufferin has also written: "Despotism not only destroys the seeds of liberty but renders the soil upon which it has trampled incapable of growing the plant."

This is America's problem! To grow there under such adverse influences the plant of self-government. And with its growth to approaching maturity, to be prepared to leave Haiti with assurance that that plant will continue to blossom perennially under the guidance of such Haitian administrators as we may be able to indoctrinate with the American ideals of self-government.

The author pleads, and this reviewer thinks he rightly advocates, that a larger share in the administration of the government of Haiti be now exercised by that class of the people he styles the élite. It is from them the rulers of Haiti were heretofore drawn. It is from them its future governmental officials must come. Practical experience for them, under our guidance, in all phases of governmental adminis-

tration, should be our policy, he says. Admittedly, Mr. Davis states, that will be more expensive. Our present policy seems to be to make the meager funds allotted for current administration go as far as possible to satisfy the urgent needs of the country. Economical administration can best be had in this particular by the more responsible American official. But the ultimate aim should not be overlooked. We are to leave Haiti in safer hands, and those hands we must train now! Under present conditions, Mr. Davis says, it is impossible that a genuine and efficient democratic government can be established in Haiti before the expiration of our treaty. He adds: "But regardless of concrete results which have been achieved toward efficiency, it is clear that our present program has not tended toward the establishment of a Haitian democracy."

The difficulties that stand in the way of America's task in this particular, the author recognizes. The treaty, he says, for reasons best known to its framers, failed to include American supervision over public education. It likewise ignored another vitally important department—the judiciary. The lower courts of Haiti, the author states, are not only corrupt, venal and inefficient, but are generally highly partisan, anti-foreign, and particularly anti-American; a condition that has led all foreign investors to the expediency of providing, in any grants or concessions they may have procured for development of Haiti's resources, for the adjustment of controversial matters arising thereunder by the method of "settlement out of court." The amendments more recently adopted to the constitution of Haiti may ameliorate this condition.

As for public education, Mr. Davis writes, recently the Service Technique de l'Agriculture has taken over a program of elementary education in connection with its farm schools in certain isolated districts which have never been provided with adequate school facilities. The peasant of Haiti who has lived under that despotic system destructive of any hope for advancement, political, moral or social, has today not the faintest conception of his rights nor any knowledge of conditions outside the neighborhood where he dwells. Popular education means much to his next generation. The founders of the American republic regarded free public schools as part of the democratic system of government. Franklin said that public schools were needed "to supply men to serve the public." In 1920, the present commandant of the Marine Corps said: "The United States might have anticipated a failure on the part of the Haitian government to efficiently and satisfactorily perform this duty of education; the fact confronts the United States at this time that the duty has been unperformed and also that . . . . unless the United States does assist, the Republic of Haiti will never evolve to such a self-sustaining status that the United States would be justified in withdrawing." While it would seem that the people of Haiti have not been endowed with the idea of good self-government, yet it would seem there is no need to imagine that the Haitian people have proved themselves impervious to all the teachings of civic morality we endeavor to practice. Nor are we justified in assuming them incapable of apprehending the axioms of government. The Haitian people are not be to condemned as forever incapable of managing their own affairs.

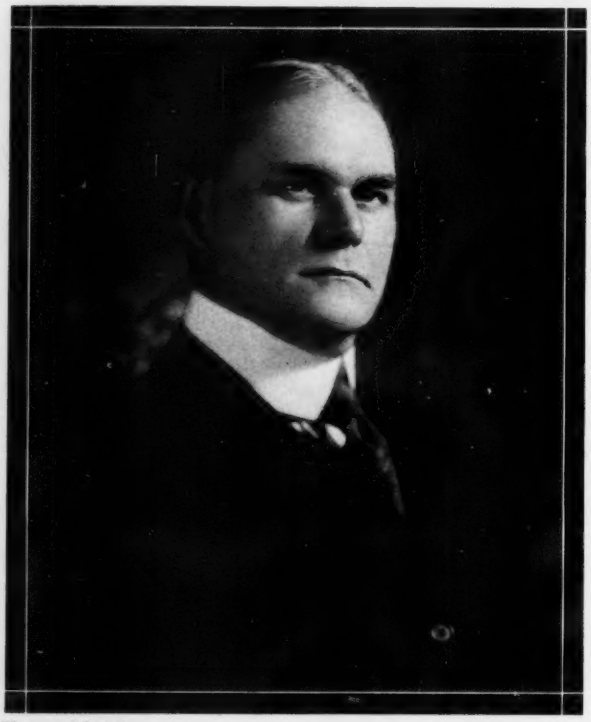
Mr. Davis has dealt fairly with all officers of the naval service, particularly those of the Marine Corps, whose services left an imprint upon the pages of the recent history of Haiti. His criticisms may not be welcomed by some, but that they are well intentioned and constructive cannot be denied. And constructive criticism, this reviewer would add, ought to be received with pleasure by those who have had responsibilities in relation to the problems of Haiti.

Mr. Davis' publication will be read with interest by all students of Caribbean problems, for it is a valuable collection of facts as well as a vital narrative of the entire history of Haiti and of the Haitian people. It cannot fail to be received as a publication tending to deepen still further the respect of the American public for the endeavor of the American treaty officials to accomplish something for the good of the Republic of Haiti.

Acme Newspictures

AN HISTORIC RELIC FROM THE *S-4*

Presentation of the wrench used by the late Lieutenant (Junior Grade) Graham N. Fitch, U.S. Navy, to tap out messages while trapped in the torpedo compartment of the U.S.S. *S-4* after that vessel had been rammed and sunk on December 17, 1927, off Provincetown, Massachusetts. The presentation of the wrench took place in the Library, U.S. Naval Academy, with appropriate ceremonies on May 17, 1928, the photograph showing Colonel Graham D. Fitch, U.S.A., and Mrs. Fitch, parents of Lieutenant Fitch, their daughter, Miss Fitch, and Rear Admiral L. M. Nulton, Superintendent, U. S. Naval Academy. The card accompanying the wrench gives a record of the messages passed between Lieutenant Fitch and the anxious workers on the surface.



Photograph by Marceau

Distinguished Naval Academy Graduates in Civil Life

Stuart Warren Cramer

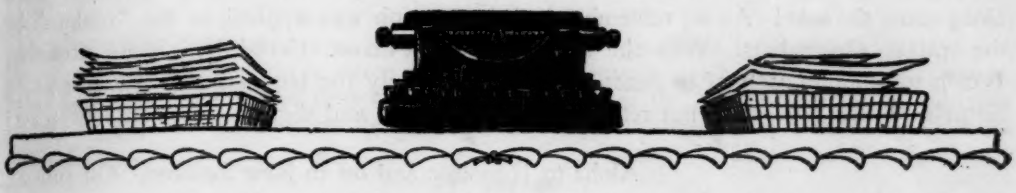
STUART WARREN CRAMER, manufacturer, born Thomasville, North Carolina, March 31, 1868; son of John Thomas and Mary Jane (Thomas) C.; graduated U. S. Naval Academy 1888; studied School of Mines (Columbia) 1889; married Bertha Hobart Berry, of Portland, Maine, June 24, 1889 (died 1895); children: Katharine Cramer Woodman, Stuart Warren; married second, Kate Stanwood Berry, of Portland, Maine, September 7, 1896, (died 1897); married third, Rebecca Warren Tinkham, of Boston, Massachusetts, January 28, 1902; one son, George Bennett. Resigned from U. S. Navy, 1888; assayer in charge U. S. Assay Office, Charlotte, North Carolina, 1889–1893; engineer and manufacturer D. A. Tompkins Company, Charlotte, 1893–1895; mill engineer and contractor, Charlotte, 1895–1918; president and treasurer Mays Mills, Mayflower Mills, Cramerton Mills, Inc. Owner of the Mayfarm and Orchards; officer or director various financial, manufacturing and railroad corporations. Granted about sixty U. S. and foreign patents as result of research in trade chemistry and physics. Organizer and first commander North Carolina Naval Reserve, 1890–1893; member of Board of Visitors, U. S. Naval Academy 1912 and 1926; life member U. S. Naval Institute 1889; member production engineering commission, Council National Defense, World War; was also member war service commission; member advisory tax board of Treasury Department; member American Cotton Manufacturers Association (president 1916–1917); National Council American Cotton Manufacturers (president 1917–1918 and since 1920); National Association Cotton Manufacturers (medalist 1913). First vice president of Cotton-Textile Institute, New York; member National Industrial Conference Board; member American Commission of International Chamber of Commerce, 1923; National Commission on Inheritance Taxation, 1925; Delegate Republican National Convention, 1928; member national committee to notify Herbert Hoover of Presidential nomination; Republican Presidential elector-at-large, North Carolina, 1928. Republican, Episcopalian.

CLUBS: Manufacturers, Country (Charlotte); Engineers, (New York); Gastonia Golf.

AUTHOR: *Useful Information for Cotton Manufacturers*, (4 vols.), 1904–1909; also various monographs on industrial economics.

HOME: Cramerton, North Carolina.

SECRETARY'S NOTES



Control of the Sea and the War of '98

The Battle of Santiago marked the passing of Spain as a governing power in the Americas. With no means of supplying her troops in Cuba, it was only a question of time until those troops would have to surrender. An inadequate navy spelled the downfall of Spanish influence in an area she had in a large way dominated for centuries.

Cervera, like many another naval commander, did his best with the means at hand, but the "little navy" politicians of Spain had so weakened his forces and equipment that he was unable to put up even a fair fight.

Mere bravery will not win a modern, scientific battle. It requires, in addition, equipment and training. And *sufficient* equipment to meet the enemy at least on even terms. If Spain was unable to afford such equipment, then her passing was inevitable. But if she *neglected* to supply her people with a military establishment sufficient for her needs, having the necessary funds, then her passing was the result either of indifference or of treachery on the part of her governing body.

Whatever the reason, Admiral Cervera, his officers and men paid the cost with their lives and blood.

A Paradox

The two great political parties have met, have selected their candidates for President and Vice-President, and have announced their platforms. Both have declared themselves in favor of adequate national defense. Yet the cruiser program was allowed to be held up by "little Americans!"

Latitude and License

Speaking of "little Americans," we note that the Anti-Imperialistic League held a demonstration in Wall Street recently. As usual, decoys of young persons were mixed up with their elders. It makes the demonstration appear innocent. Latitude breeds license, license breeds violence.

In the Air

The *Southern Cross* makes the longest hop, skip, and jump ever recorded; a hop to Hawaii of 2,200 miles, a skip to Fiji of 3,400 miles, and a jump to the mainland of 1,200 miles. The seaplane *Friendship* crosses the Atlantic from west to east, with a lady passenger. The Italians fly from Rome to Point Natal on the South American mainland. German aviators remain in the air sixty-five hours. Heroic deeds are being performed in the Far North by the rescue parties trying to save the survivors of the *Italia,* lost on her return from a flight across the North Pole.

Records fall daily, new deeds of daring startle the world each morning.

What is a Gob? For years the bluejackets fought against the use of the word sailor or sailor boy in connection with their profession. They wanted to be called bluejackets, which identified them as uniformed enlisted men, serving the government of the United States. Eventually this was accomplished. Then along came the war! As we remember it the term gob was applied to the "rookies" by the trained bluejackets. Why the name, we do not know. Certainly, it is not attractive. It calls to mind all sorts of unpleasant things. Certainly the bluejackets are entitled to a better title than gob. Why not return to the distinctive and dignified title of bluejacket?

The Fleet Enters the Land of the Southern Cross Aloha to Honolulu and off to New Zealand. On July 23, 1908, the battleships sailed from Honolulu to make their next stop at Auckland, New Zealand. This was the longest leg of the cruise yet made. On the way, the fleet passed close to Pago Pago, Samoa, where it was greeted by the U.S.S. *Annapolis,* station ship at Samoa.

We had some bad weather before reaching New Zealand, but arrived on schedule, August 9. And what a reception! It seemed that all New Zealand was there and that everyone was bent on giving us the best possible time. Special horse races had been arranged, all sorts of other entertainment, and the trip to Rotorua! Rotorua in a way resembles Yellowstone Park, with its hot springs, geysers, etc. It was a novelty to most of the officers to see food cooked by simply digging a hole in the ground and putting a kettle in it.

The Maori tribes were most interesting and outdid themselves in giving their songs and war dances.

The American officers afforded probably the greatest surprise, for on the train to Rotorua, they learned the Maori war-cry. And on disembarking, the Maoris were astonished and delighted at being greeted by their own war-cry.

It goes something like this, phonetically, at least:

Ka Mate-Ka Mate-Kaora-Kaora, (accompanied with stamping of feet)
Ka Mate-Ka Mate-Kaora-Kaora,
Tini-te-tangata-po-hura-hura,
Nana-tiki-my-faka-whiti-te-ra,
Hoo-pani-hoo-pani
Hoo-pani-kow-pani-whiti-te-ra.

After Auckland, the fleet next stopped at Sydney, arriving there August 20. Sydney has one of the most beautiful harbors in the world; perfectly protected from weather and lovely to look at.

Our welcome in Sydney was wonderful. Everyone was busy from morning until night keeping up with the party. The New Zealanders and Australians seem to like Americans in a more natural way than most any other people.

In the World War, Anzacs, Canadians, and Americans seemed to fraternize more easily. Probably it is due to a similarity of ideals.

At any rate, the fleet was at home in Sydney.

A Sailor's Log Off Santiago Mr. James A. Montgomery, an associate member, lent us his log which he kept during the time he was serving on the U.S.S. *New Orleans,* operating with the fleet off Santiago in 1898. The *New Orleans* was one of the ships purchased from England shortly before the outbreak

of war. The portion of the log quoted gives the facts of the engagements in which the *New Orleans* took part, without any embellishments.

IOWA, MASSACHUSETTS, NEW ORLEANS

First Engagement

May 30, 1898, from 2:10 to 3:30 A.M. Had engagement with three forts and *Cristobal Colon*, first class Spanish cruiser, killing eleven men including a Spanish major general, who was superintending the removing of a gun from *Cristobal Colon* to one of the forts, and wounding thirty-six others, no casualties on American side. This being my first engagement, my thoughts went to home and mother.

Second Engagement

June 3, 1898, at 11:15 P.M. This ship discovered Spanish torpedo boat heading for us. We promptly opened fire and sank her. Next morning the U. S. torpedo boat *Porter* was sent to see what damage was done, and picked up two Spanish torpedoes which were believed to have been fired at this ship and by some fault of the air pressure that controlled the mechanism they failed to carry to where they were aimed. If one or both had hit us, it would be good night.

Third Engagement

June 6, 1898, 6:10 to 10:20 A.M. Entire fleet consisting of *New Orleans, Mayflower, Vixen, Porter, New York, Oregon, Massachusetts, Texas, Brooklyn,* and *Marblehead,* bombarded Santiago, forts returning the fire. We silenced the forts in a short time, but continued on firing line until Spanish troops were routed and forts destroyed. This ship nearest to shore batteries distant 1,900 yards; could see wounded soldiers lying about fort. Think we inflicted heavy losses on enemy, as we did some fine shooting. One man wounded on U.S.S. *Suwanee;* no other losses. Saturday, June 11, 1898. Steam steering gear broke down. Sunday, June 12, sent gear to U.S.S. *America* to be transported to Key West, Florida, to be repaired. Steering by hand wheel.

Fourth Engagement

June 13, 1898. This vessel observed the enemy. Extending fort to west of Moro, and mounting guns, reported this to flagship, and was ordered to go inshore early next morning and destroy works. We observed building June 14, 4:30 A.M. Went in to engage forts. Enemy keeping up steady fire at us while we were steaming in. When we got within 1,800 yards of enemy, we opened fire on two batteries—they returning the compliment, but very slow. No other ship within four miles in this engagement. Spanish shots falling short and over us, but good line shots. After engaging enemy from about 4:30 to 6:45 A.M. and destroying all fortifications, we drew off. Enemy began firing from masked battery that we had not discovered, and was trying to rake us. The best shot they made was in this attack. A shot came from the Dons, over our stern along the port side, close amidship, continued on its journey over the bow and exploded ten feet ahead of us, and dropped harmlessly in the water. If it had hit us, someone would have been consigned to Davie Jones' locker. As it was we had not a soul killed or wounded, although we thought when we went in that we would not come out again. As this being the only ship in this fight, all the Spanish batteries concentrated their entire fire upon us. We heard later that the enemy called this ship the *Black Hornet,* after this fight.

When the captain reported results of engagement to the admiral and returned aboard, he said the admiral complimented him, his officers and crew, and told him that we did more damage than the entire fleet did in their engagement on June 6.

Fifth Engagement

June 16, 1898, from 4:30 to 6:05 A.M. Entire fleet engaged forts at Santiago and destroyed works. Admiral Sampson signalled this ship, "Distinguishing pennant R 173, Well done, *New Orleans.*" Do not know what loss enemy suffered. No casualties on American side.

June 20, 1898. About 4:00 P.M. transports with American Army arrived off Santiago. The next day, June 21, this ship was assigned to examine the beach at Daiguiri, a small town about ten miles down the coast from Santiago, and find a landing for troops. We found a suitable place and reported to flagship. On June 22 we convoyed transports to Daiguiri and opened fire, putting enemy to rout, they setting fire to everything that may prove of value to us. At 10:05 A.M. of June 22, the first

American soldiers landed in Cuba, many never to return. Our large boats being the second inshore the troops landed without resistance and were met ashore by a large force of the Cuban Army, who heartily greeted them. This same day the U.S.S. *Texas*, the hoodoo of the Navy, engaged the forts at Santiago, and was struck once by the enemy, killing one man and wounding five others, the first American ship to be hit by the enemy.

Our First Line-of-Battle Ship, the "America"

Last month, in the "Secretary's Notes," we mentioned the fact that the *America*, to whose command John Paul Jones was ordered, was turned over to the French and eventually fell into the hands of the English. This statement was made as a result of the following letters given the Naval Institute by Rear Admiral Elliot Snow (CC), U.S.N. (Retired).

The first letter was from the Admiralty to the late Captain H. D. Smith, U.S.R.C.S., and is as follows:

ADMIRALTY
OCTOBER 17, 1913

SIR:

In reply to your letter of the 29th ultimo, requesting information as to the line-of-battle ship *America*, I am commanded by my Lords Commissioners of the Admiralty to inform you that the *America* was captured from the French by Lord Howe, in the battle of June 1, 1794, and was added to the British Admiralty as *Impétueux*, the name *America* already being in use.

As *Impétueux* she took part in the following operations:

1797. Implicated in mutiny at Spithead.
1798 (April 5). Captured with aid of *Sylph* (16), the French *Chasse-Maree Sainte Famille.*
1799. In Keith's fleet in chase of the allied fleets.
1800. Operations near Quiberon.
(June 6) Boats burnt *Insolente* (16) in Bay of Biscay.
(July 29) Cut out *Cerbère* (7) at Port Louis.
(August-October) The Fenal Expedition.
1808. She was taken to pieces at Chatham in 1813.

The *America* cut down to 50 guns was a British ship of that name.

I am, Sir.
Your Obedient Servant,

W. J. EVANS

To
Captain Commandant H. D. Smith
41 Wilson Avenue
Flushing, New York, U.S.A.

Rear Admiral Snow wrote to the Admiralty concerning this letter as follows:

60 STOCKTON STREET
PRINCETON, NEW JERSEY
DECEMBER 17, 1927

The Secretary
The Admiralty, Whitehall
London S.W., England

Subject—Line-of-battle Ship *America.*

References—(a) Admiralty's letter R.O., of October 17, 1913, addressed to the late Captain Commandant Horatio D. Smith, U.S.R.C.S. (now U. S. Coast Guard Service), then living at 41 Wilson Avenue, Flushing, New York.
(b) *The True Story of the America* by R. W. Neeser (PROCEEDINGS, U. S. Naval Institute, 1908).

DEAR SIR:

I have been fortunate enough to come into possession of letter ref. (a) signed by W. J. Evans and believing that the Admiralty will desire and welcome more detailed and accurate information con-

cerning the vessel evidently made the subject of an inquiry by the late Capt. H. D. Smith, U.S.R.C.S., its attention is drawn to reference (b).

From that ref. (b) it is apparent that *L'Amérique* of the French Navy captured by Lord Howe, June 1, 1794, was entirely of French design and construction and was not the first line-of-battle ship *America* built at Portsmouth, N.H., 1777-1782.

Yours truly,

ELLIOT SNOW
Rear Admiral (CC), U. S. Navy

The Admiralty replied to Rear Admiral Snow in the following manner:

ADMIRALTY S. W. 1
JANUARY 11, 1928

Reference No. Lib. 245/27

SIR:

I am commanded by my Lords Commissioners of the Admiralty to thank you for your letter of December 17 relative to the early history of *L'Amérique*. There are however one or two points in which the account in the PROCEEDINGS of the United States Naval Institute to which you refer is inaccurate and you may like to have a note of them. They are as follows:

Page 577. The 64-gun ship *America* built in 1777 was not burned in Portsmouth Harbour. She was sold out of service in 1807.

Page 578. This statement of burning is transferred to the *Impétueux* (the name given to the captured *L'Amérique*). This also is not true, as that ship was broken up in 1813. The alternative statement that the ship was in use as a store ship at Bahia is also inaccurate.

Page 580. It was not at Aboukir (Battle of the Nile), but four years earlier that *L'Amérique* was captured.

I am sir and etc.,

CHARLES WALKER

Rear Admiral Elliot Snow (CC), U. S. Navy
60 Stockton Street
Princeton, New Jersey, U.S.A.

From the above there is no doubt in the minds of the Admiralty but that the *America* was captured by Lord Howe in the battle of June 1, 1794, and entered the British service as the *Impétueux*, eventually being broken up in 1813.

Change in Board of Control

Due to receipt of orders to sea duty, Captain Gilbert J. Rowcliff, U. S. Navy, resigned as a member of the Board of Control. Commander Oscar Smith, U. S. Navy, has been appointed to succeed Captain Rowcliff.

Instructions For Contributors and Members

Contributors Are Well Paid for Articles

All articles appearing in the main body of the PROCEEDINGS (except the Special Information Number, commemorative of Navy Day, usually published in October) are paid for by the Institute at good rates. The same applies to the acceptance of discussions, book reviews, and photographs.

The following will govern the acceptance of the manuscript referred to above:

(a) The date of appearance of any article is at the discretion of the Board of Control, which further reserves the right not to publish the article should it appear desirable for any reason to take such action.

(b) Articles become the property of the Institute upon acceptance of payment by the author, and they will be copyrighted by the Institute upon publication. They cannot be used for any purpose whatsoever before or after publication, except by permission of the Naval Institute.

(c) In accepting articles for publication the Institute reserves the right to have them revised or rearranged when necessary in order to bring them up to the required standard of articles published in the PROCEEDINGS—deducting the cost, if any, from the compensation of the author.

Articles

The Institute desires articles of interest to all branches of the service, including the reserve force. Non-members as well as members may submit articles, and authors receive due compensation for articles published. *Compact, well digested articles are more likely to be accepted for early publication.*

Contributors are requested to observe the following special instructions in preparing articles for the PROCEEDINGS:

(a) In writing names of ships put only the initials in capitals and underscore the names. The underscoring signifies to the printer that the word is to be in italics. The same applies to names of publications. Foreign words not anglicized should also be italicized.

(b) In preparing tables and computations employing fractions, sub-numbers, etc., do by hand that part which cannot be made perfectly clear by the typewriter.

(c) In typing script use double space between lines.

(d) When a quotation is included in an article the editor should be assured by appropriate notation that the writer has carefully verified the quotation as presented.

Reprints

Authors of published articles are entitled to twenty gratis copies of reprints.

Discussions

Discussion of articles published in the PROCEEDINGS is cordially invited. Discussions accepted for publication are paid for at approximately one-half the rate of original articles.

Book Reviews

As soon as practicable after the publication of books on subjects of professional interest, the Institute aims to publish authoritative reviews of them, reviewers being remunerated.

Photographs

Unusual photographs, whether old or modern, if of nautical or naval interest, and sufficiently clear cut to be suitable for the engraver, are desired. They will be purchased.

Address of Members

In the past, many errors have resulted from the habit of changing an officer's address as soon as his transfer orders are published in the papers. No change will be made in the future except upon receipt of notification by the members concerned. Reliance upon the former method may, in extreme cases, mean a delay of almost four months. To insure the prompt delivery of the PROCEEDINGS and other communications from the U. S. Naval Institute, it is essential that members and subscribers *notify the Secretary-Treasurer without delay of every change of address.* No responsibility can be accepted for failure to receive the PROCEEDINGS, where members fail to comply with this rule. Changes of address should reach the Institute by the 20th of the month, to be effective for the issue of the PROCEEDINGS of the following month.